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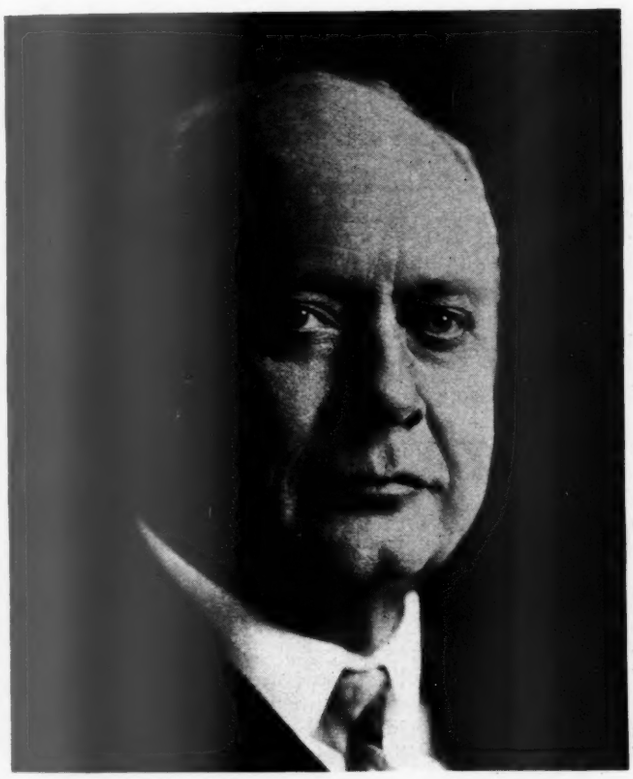
# Training Supervisors



L. W. Baldwin

**Morale and fighting spirit depend upon qualities of leadership and railroads must have men properly equipped to direct the efforts of rank and file**

At the joint opening session of the annual conventions of the Locomotive Maintenance Officers' Association, the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association and the Master Boiler Makers' Association, L. W. Baldwin, chief executive officer, Missouri Pacific delivered an address under the title, "Training and Coaching Supervision." An abstract of Mr. Baldwin's address follows:

Training and Coaching Supervision is a broad and most important subject and one deserving of the earnest study and thought of every railroad man interested in the continued advancement and success of the railway industry. I won't go so far as to say that the proper training of supervision is the most important factor in the success of railway operations, but I will say that it is one of the most important ones.

I am not a military man, nor even one with militaristic leanings, but I do know that the success of an army depends upon the quality of its leadership, and by that I mean not the generals so much as the captains, the lieutenants, the sergeants and the corporals, for it is up to them to keep up the morale, the fighting spirit and the efficiency of the rank and file. And it is the rank and file that wins wars, and, in the last analysis, determines the success or failure of any industry. Hence it is perfectly clear that a railroad, in order to attain top efficiency, must have men well equipped to direct properly the efforts of its rank and file—those who actually perform the proverbial thousand and one tasks that are necessary to keep the wheels turning, and to deliver the kind of service for which our American rail system is so justly famed.

The finest railway plant in the world would be of little value to those who invested in it or to the public it was built to serve if it were not manned by competent employees. The greater the competence of the men who operate it, the greater its value to those who have invested in it, and to the public. Now it is equally true and equally obvious that competence doesn't just happen. Men become competent through experience and through education. To my mind the old saying that experience is the best teacher borders on being a half-truth because it seems to have left the impression in the minds of many that experience is the *only* teacher, and that, of course, is not true.

There was a time when everyone who advanced did so because he had been a good pupil in the school of experience. Today there is no thoroughly satisfactory short cut that can be followed exclusively, and experience still is a necessary adjunct to success, but training and proper coaching have made the way not only easier but much more efficient. Today, thanks to training courses, to able teachers, constructive thinking and cooperative direction, it is possible for a man to become proficient in much less time than was required for him to obtain the same degree of proficiency in the days when only those who had learned their trade the hard way were considered worthy of leadership.

From that date a little more than a hundred years ago, when the first train laboriously chugged its way along a track, to the amazement of all—including probably its builders and sponsors—the history of railroading has been one of progress. There is not a man in this room who, if he will think back to the days when his name first went on a railroad payroll, cannot recall a steady procession of improvements and betterments. We who have devoted our lives to the railway industry find a strong fascination in our calling. We wouldn't be happy doing anything else. "Railroading gets in one's blood," is a rather often-heard expression. I think that is true, but I think it gets in our blood because in most of us there is a natural desire to have a part in

something that is vital, something that spells progress and service. We are proud to be known as railroaders because no industry has a finer, more inspiring and more impressive record of achievement, and this, too, in spite of the fact that in recent years, when it has achieved its greatest advancement, it has been confronted with its greatest difficulties.

### Railroading Has Attracted Men of Vision

I think it can truthfully be said that the railroad industry has made its enviable record because it has attracted to it men with rare qualities of leadership, men of vision, men with a pride in their craft, and, above all else, men richly imbued with a zeal for service. It is men like these who constitute the real backbone of the railroad industry. From men like these have been chosen the captains, the lieutenants, the sergeants and the corporals of the great army of railroaders. They have been chosen as leaders because they possess certain qualities that enabled them to assume and to discharge responsibilities properly, because they knew their business and chiefly, in my opinion, because they had proved they had open minds.

No man can be a good leader of men who believes, or who even acts as if he believes that he knows all there is to be known about his task. Railroading is an industry of movement. Trains move today at a speed and with a dependability undreamed of a few decades ago. This was made possible by the combined efforts of countless men who continually sought new and better ways of doing their work. If railroaders, and particularly supervisors, had closed minds; if their eyes and ears were not always open to suggestions, and if there did not burn in them a constant desire for improvement, why then ours would, indeed, be a dying industry.

But the railroad industry is as far from being that as daylight is from darkness. It has had and is having its full share of trials and tribulations. It has been hammered and hampered by antiquated rules and regulations. It has suffered and is suffering from unfair and subsidized competition. But serious as they have proved, they have never dampened and will not dampen the inherent enthusiasm and determination of railroad men to progress—to find new and better ways of getting their work done and to better the quality of their service to the public.

The entire history of our railroading shows that change is as inevitable as death and taxes. As I have said, ours is an industry of motion. Like individuals, institutions and organizations of all kinds, the railroads must go forward or slip backward. There is no such thing as a standstill railroad any more than there is an individual who, over a period of years, does not either become more efficient or less efficient.

This fact makes heavy the responsibilities of railroad officers and their assistants, the supervisors, for it is, of course, their duty to see that this progress is not only continued but accelerated. And that brings us face to face with the problem of training and coaching supervision. For one thing, I think it should be brought home to each supervisor that if he does not devote at least a part of his time to study, planning and thinking he cannot be very successful in his efforts to inspire his men to greater efficiency and greater loyalty.

### Efficient Supervision of Work Not the Only Requisite

In this day when success is so utterly dependent upon efficiency it is quite clear that no supervisor can be content with merely seeing to it that his men turn out a specified amount of work. As I have said, tremendous forward strides have been taken in all branches of railroading but there are still vast improvements to be made, new ideas to be thought out, developed and perfected, new economies to be considered and adopted. No one has a monopoly on ideas and it is part of the supervisor's job to work with and to co-operate with his men so that they will be thinking along new and progressive lines.

This cannot be done except through the maintenance of proper relations between supervisors and the rank and file, and I think the supervisor who allows himself to lose touch with his men is overlooking a major requisite to his own advancement and is not getting the best possible results from them. Naturally this same observation applies with equal force to contacts between officers and their supervisors.

What we know as "good organization" depends upon the extent to which officers keep in close touch with their supervisors and upon the supervisors maintaining close personal relationships with their men. Good organization means a complete understanding by everyone of what is to be accomplished, the manner in which it is to be accomplished and perfect co-ordination of both effort and knowledge.

The matter of proper co-ordination is a most important one and should, I think, be emphasized in all coaching of supervisors. A supervisor may be outstanding in the handling of his men, he may get from them the best possible co-operation and produce satisfactory results, keep his costs down and his records in perfect shape, and do all of the other things that are expected of him, but still be a failure as a supervisor if he loses sight of the organization as a whole and regards the operations of his force as something separate and apart from other forces.

The modern railroad is the most perfect example of big scale co-operation ever developed. Any individual who forgets for a moment the absolute need for and value of co-operation is not properly filling his niche, or living up to the traditions of our industry. Co-operation, however, is dependent upon understanding and the responsibility for bringing about a proper understanding on the part of the supervisors, and developing and maintaining in them a proper attitude toward their duties and their responsibilities calls for careful and painstaking coaching. In my opinion, this cannot be done by writing out instructions, by issuance of bulletins or in any way except by personal contact.

Coaching of supervisors should not be confined entirely to matters relating directly to better shop practices, better co-operation between forces or other phases of the actual work. It should also include efforts to bring about a better and more thorough understanding of the railroad situation and a greater sense of responsibility on the part of all employees to do all they can for the benefit of the industry in general, and for their own railroad in particular.

It is inconceivable that a man who works for a railroad and who knows that railroad employment and railway revenue have been constantly declining could maintain an attitude of indifference concerning the decrease in railway business, or of the causes that are responsible. And I firmly believe that if there is an employee on any railroad who seemingly is indifferent to the situation, it is because someone in an official or a supervisory capacity has failed to take the time and trouble to acquaint him thoroughly and definitely with the facts.

An aroused and active army of railway employees, standing shoulder to shoulder, and fighting earnestly and sincerely for legislation that would eliminate handicaps

(*Continued on page 502*)

**Constructive Reports Presented at Meeting of**

# Master Boiler Makers

A TOTAL of 165 members of the Master Boiler Makers' Association, over 50 per cent of its membership, registered at the twenty-sixth annual meeting at Chicago on Oct. 17, 18, and 19. The president, W. N. Moore, general boiler foreman, Pere Marquette, opened the meeting with a brief address of welcome.

The address by Roy V. Wright, editor, *Railway Mechanical Engineer,* was the first of several stimulating addresses and lectures by railroad and government executives. Among the speakers were D. S. Ellis, chief mechanical officer, Chesapeake & Ohio; F. K. Mitchell, assistant superintendent of equipment, Cleveland, Cincinnati, Chicago & St. Louis; J. M. Hall, chief locomotive inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission; M. M. Hanson, principal field representative of the United States Department of Labor, Federal Committee on Apprenticeship. Lectures were delivered by Dr. W. C. Schroeder, senior chemical engineer, United States Department of Interior, Bureau of Mines, on the Causes and Prevention of Embrittlement in Locomotive Boilers*; and by C. M. Rogers, Locomotive Firebox Company, on Circulation of Water in the Boiler, which included a showing of motion pictures.

**Apprentice training, renewal of fireboxes, circulation of water, feedwater treatment, and welded construction of tender cistern were some of the subjects included in the program**

Eight technical reports were presented during the meeting. Among these was a report submitted by committee chairman, F. A. Longo, welding and boiler supervisor, Southern Pacific, on the renewal of fireboxes. An abstract of this report will be published in a later issue.

## The Election of Officers

The following officers were elected to direct the activities of the association during the coming year: President, C. A. Harper, general boiler inspector, Cleveland, Cincinnati, Chicago and St. Louis, Indianapolis, Ind.; vice-president and chairman of the executive board, C. W. Buffington, general master boilermaker, Chesapeake & Ohio, Huntington, W. Va.; secretary-treasurer, A. F. Stiglmeier, general boiler foreman, New York Central, Albany, N. Y.; executive board members, C. J. Klein, locomotive inspector, Interstate Commerce Commission, Albany, N. Y.; E. E. Owens, general boiler inspector, Union Pacific, Lincoln, Neb.; F. A. Longo, welding and boiler supervisor, Southern Pacific, Glendale, Cal.; R. W. Barrett, general boiler foreman, Canadian National, Stratford, Ont., B. C. King, general boiler inspector, Northern Pacific, St. Paul, Minn. The following continue as members of the executive board: M. C. France, general boiler foreman, St. Paul, Minneapolis and Omaha, St. Paul, Minn.; L. R. Haase, district boiler inspector, Baltimore and Ohio, Baltimore, Md.; and E. C. Umlauf, supervisor of boilers, Erie, Susquehanna, Pa.

* An abstract of this lecture will be published in a later issue.

Carl Harper
Vice-President

W. N. Moore, President

A. F. Stiglmeier
Secretary-Treasurer

# How the Association May Better Serve the Railroads

**By F. K. Mitchell**

Assistant Superintendent of Equipment, Cleveland, Cincinnati, Chicago and St. Louis

Your association came into being in 1906 when the old Master Steam Boiler Makers' Association and the International Railway Boiler Makers' Association were consolidated, and your first regular convention was held in 1907. At that time there was a crying need for such an organization. Boiler design and maintenance was indeed a crude and primitive art. A boilermaker was just a necessary evil and his standing among railroad employees was near the bottom. There were no federal laws covering the construction, inspection and maintenance of locomotive boilers and their appurtenances. There was no serious regard for the safety of the employees building, operating, or maintaining them. Tools, material, machinery and personnel were inadequate, methods crude, and the performance of the boilers in service was no better than such conditions could be expected to produce. The problems of the boiler supervisor must have seemed almost insurmountable—he had nothing but criticism from all sides, no place to go for advice, and no way of knowing how the other fellow was meeting similar problems. Under such conditions something had to be done, and the creation of the Master Boiler Markers' Association was one of the most important steps toward the solution.

### Introduction of New Ideas—Real Battle

The minutes of your conventions are a saga of railroad operation and maintenance improvement, as interesting as any story ever written. Yet even they do not reflect the real battle which has gone on. I know a little of what this battle has been, because of the fact that it has been my privilege for a good many years to be associated quite intimately with one of your members, whom I consider to have no peer as a boilermaker and a boiler supervisor. For hours I have discussed with him the problems of boiler work peculiar to our road and have spent days with him inspecting boilers and fireboxes and examining boiler inspectors. He has given me freely of his knowledge of boiler work and I have profited thereby, as no doubt many a fellow employee of each of you has done on your respective roads. I have shared with him his pleasure in seeing his ideas or ideas brought back from your convention prove astoundingly successful and his disappointment at not being able to put over other ideas. Everyone of you, no doubt, has had the experience of going back to your immediate supervisor with an idea which you knew full well to be sound that would result in economies and yet you could not put it over because it was going to cost something to do it. All too often improvements and new ideas had to be accomplished in spite of your superior officers and not by reason of their co-operation.

### Valuable Assistance by Supply Group

Whether you appreciate the fact or not, one of your greatest allies in this endless battle has been your supply members and friends. They have gathered here with you, heard your problems, and putting their resources and engineering staffs to work have developed tools and machinery to produce a solution. Furthermore, they have been able in many cases to sell ideas to your superior officers where you yourselves could not. True enough, in some cases their motives may have been largely mercenary, yet in the main where they have profited, the railroads have profited to a far greater extent. Regardless of how your achievements may have been won, whether by direct contact and the co-operation of your immediate superiors, or through other channels, the fact remains that you are one of the most important factors in bringing locomotive operation and maintenance to its present high standard.

Twenty-five years ago boiler and flue failures were the bane of any superintendent of motive power's life and every time he analyzed his maintenance costs he invariably found that boiler work and boiler washing were responsible for his poor showing. Today, if he could keep his other failures down to the standard established for boiler and flue failures he would be happy and furthermore, he no longer finds that boiler maintenance and related costs are the big item of his expense. You have, in a large measure, taken that worry off his mind.

Enough has now been said as to what you have so far accomplished. You all appreciate that the job will never be done. New and complicated problems arise daily and will continue to do so. You must and will carry on.

### Association Makes No Recommendations

How can an organization which has accomplished so much good, become more useful and more nearly accomplish its ideals? A cold analysis of this subject leads me to the conclusion that your success thus far has been because of the high quality of your membership and not because of the character of your organization. In other words, you are functioning far better as individuals than you are as an association.

To point out more clearly what I am driving at, let us assume any one question as to boiler maintenance or construction, and ask what the Master Boiler Makers' Association thinks about it or recommends in connection with it. The only answer you can possibly get is that the association neither thinks nor recommends anything. Its individual members have good ideas and recommendations to make on any subject with which they are individually familiar, but the association does not. Study the proceedings of any of your conventions and you will have to come to that conclusion. Any volume of these proceedings carries fine papers on many important subjects but, in the last analysis, these papers represent the individual opinions of a few of the members who have been either on the committee assigned to prepare the paper, or in some cases other members who have been consulted by the committee. In addition, there may be some further light thrown on the subject by discussion from the floor, but you will not be able to tell what the association, as a whole, thinks of the subject or would recommend as a solution to the problem.

Perhaps you have in the past taken the wrong, or too narrow interpretation of one little word found under the caption "Object" in your constitution and by-laws. I quote that part of your constitution and by-laws in full: "Object: The object of this association shall be the mutual improvement of its members by an exchange of ideas in meetings, the reading and discussion of papers and a general interchange of views so that all may profit by the experience of others more proficient in our Craft."

That in itself is a noble ideal which has been, in the

past, a radio beacon directing you toward your goal. If the word "all" were interpreted to have been intended for use in the larger sense to mean every man or group engaged in the craft or affected by your efforts, and not to refer to the membership alone, what a different goal this beacon would be leading you to.

Consider what it would mean to apprentices, prospective boiler foremen, boiler foremen, supervisors of boilers, master mechanics, superintendents of motive power, and even to engineers of motive power and locomotive boilers, to have the consensus of opinion of the membership of an association of this kind available for their information and guidance. Furthermore, think what it would mean to your prestige as an association.

### Full-Time Secretary Required

The setting up of Recommended Standards of Practice for even boiler maintenance would entail a large amount of work and expense but, I say to you, such a set of standards for both maintenance and construction would be well worth any effort and expense involved. Naturally the question arises as to how this can be accomplished.

To begin with, the services of a full-time secretary would be required. Also a limited full-time clerical force. Questionnaires on many already well established maintenance practices could be sent to the membership (one with voting power on each railroad) in a short time, reserving the more complicated and less well established practices in maintenance until later, and not attempting any recommendations on boiler construction until the maintenance standards were well along. These questionnaires would have to be tabulated and either accepted as standard or rejected for another vote on the basis of a predetermined majority requirement.

It is an evident fact that the character of the secretary obtained would in a large measure decide the success or failure of such a plan. Your secretary, to handle such a job, should be of the highest calibre and paid an annual salary which would enable you to hold him.

To defray the expense of such a man and his necessary office force and expense, might require some such plan as the sale of sustaining memberships to each road and perhaps among supply companies for an annual payment. It is possible, however, that after the process had gone on for some time your standards could be printed in loose-leaf form (with a provision that they would be kept up annually) and sold in sufficient quantities to entirely defray the expense involved.

It is a regrettable fact that some such procedure as outlined above was not instituted by your association long ago so that such valuable information might be available at this time, yet it is not too late to start and the end will well justify the means.

So gentlemen, I am offering you these suggestions for what you may consider them worth. A good which is worth accomplishing is worth making permanent. As Shakespeare so aptly said—"The evil which men do lives after them—the good is oft interred with their bones." This may be a way of preventing one such interment.

## Association Benefits to the Railroads and Its Membership

**By D. S. Ellis**

Chief Mechanical Officer, Chesapeake and Ohio

Since time immemorial it has been the custom of humans to band in groups or associations, originally in self defense and for the protection of their mutual interests. As the defensive need for such organizations lessened through the years, it became apparent that their continuance could be made increasingly valuable through co-operation and the exchange of ideas on matters of common daily interest. Further in their evolution it was found, particularly in the case of supervisory organizations such as yours, that, while the interchange of technical as well as practical ideas and improvements was particularly beneficial to the membership in promoting individual efficiency, their ultimate value lay in their liaison position between supervisor and workman, and in their ability to help the individuals create a true spirit of mutual dependence and harmonious relationship, one with the other. It is this thought that I particularly wish to emphasize today because I feel safe in saying without fear of contradiction or challenge from both a technical and a practical standpoint, that the value of your organization is so well recognized that there is no need for further elaboration.

### Success of Railroads Depends Upon the Men

From the railroad side, I am more impressed each day with the fact that beyond all else their success is largely dependent on the attitude of the men, especially those represented by this gathering in a supervisory capacity. The great and varied facilities on our railroads, in order to function efficiently and satisfactorily, must be guided and controlled by honest, earnest and capable human agents. Bearing this in mind and assuming that the railroads are properly located and equipped, it obviously follows that the human factor is of utmost importance in helping the railroad industry to rise and move forward in the favor of the public from which its business must be derived.

This, then, is a matter of having the proper organization, interested in making this accomplishment possible. This can only be effected by each individual doing his entire duty in his appointed place. Work performed in pursuance of this principle is not the result of hazard—it is done so because some supervisor or group of supervisors has studied and planned; planned in the interest of economy and expedition and with due regard for the safety and welfare of all concerned. It is here that the supervisor of today can do most to engender cordial relationship, one to the other. By that I mean—if work is properly studied, analyzed and planned beforehand, it can be pursued to completion with a minimum expenditure of effort to the employee who has the knowledge and satisfaction of a job well done, and with the minimum expense to his company. No one has a greater opportunity to be as important a factor to his employer's business or in his employees' welfare than the foreman in the mechanical departments of our railroads; and this is particularly true in the case of the members of this organization, who handle the maintenance, repairs and building of the largest and most important single part of the steam locomotive—its boiler.

### Association's Value to Railroads

The foregoing is the gist of the message I am attempting to bring to you today. I could go into much more

detail but the fact would still remain that each supervisor has his own particular problems to cope with and these can only be met by personal experience, constant analysis and planning, as well as through the benefit of contacts with members of organizations such as this which enable him to profit by the experience of others.

If in the future as in the past the work of your organization continues to unearth and uncover undesirable practices both in construction and maintenance and you continue in the future as you have in the past to discuss all of your problems at such gatherings as this, and you can together put into further execution my thoughts as expressed to you today, the benefit of your mechanical association to the railroads and to our membership will be of such high value and great help that your importance to the industry which we represent will speak for itself and stand as mighty as the oak. Most of the thoughts expressed to you here today are not new but such truths will always bear repetition, and my sole purpose in repeating them to you is that they may renew and intensify sympathetic consideration of the problems that face each one of us, and always temper our judgment and decisions with the truth, and above all, the Golden Rule.

# Successful Supervision An Art

**By Roy V. Wright**

Editor, *Railway Mechanical Engineer*

In the first place, let me congratulate you heartily on the truly remarkable record that your association has made. Throughout your life of more than a quarter of a century, and particularly under the trying conditions through which you passed in the 30's, you have fought loyally and progressively to advance your profession in the interests of more effective and more economical railroad operation. Exhibits and conventions might be cancelled, but you went determinedly forward getting out your proceedings in one form or another every year. You have maintained a high standard of constructive and helpful reports and discussions. In the days to come, as you look back on these difficult years, you can well afford to be proud of your performance.

The problem of the master boilermaker has been made more difficult because of the rapid advances that have been made in design and construction and in the materials used. Many of you have been in the boiler department during the entire life of this association. It is interesting to note the remarkable changes that have taken place in this momentous period, which have made necessary radical modifications in boiler department practices and have greatly increased your responsibilities. As I have studied your progress and have watched the activities of your association, I have marveled at the way in which you have met these challenges, and at the type of practical and technical material you have brought out in your conventions.

## Training in Personnel Work Important

I am wondering, however, whether a greater amount of emphasis should not be placed upon the human problem in the boiler department. Two years ago Mr. Moore, who was then your president, made the following statement, which was repeated in an address made by Dexter C. Buell on the training of boilermaker apprentices: "The outstanding need in the successful operation of the boiler department today is not tools, equipment or machinery; it is men, or rather young men—apprentices who are sufficiently interested to be developed in the fine arts of the trade."

There is no question but what the boilermakers' trade has been steadily advancing to higher standards of performance and that in all probability still further advances will be made. An ample supply of well trained young men is necessary to provide for the future, and too great emphasis cannot be placed upon the importance and necessity of this. I feel strongly, however, that something further is needed, which in the next few years may be of even more vital import.

The state of the art is advancing and the demands upon the locomotive boiler are growing, but what are we doing along educational lines to train and equip the present boilermakers better to meet these demands and requirements? Or, going a step further, what are we doing as master boilermakers to keep in touch with the latest development in personnel administration, in order that we may more effectively select and coach men who will be advanced to supervisory positions in the days to come? What, also, are we doing as supervisors to take advantage of the latest ideas and the best practices of dealing with the workers?

## Successful Foreman—Or Hard-Fisted Driver?

Successful supervision is an art—a steadily progressing art, for it is not so long ago that the successful foreman was too generally pictured as a hard-fisted driver. That day has passed, although there are still some hangovers of the old type who have failed to recognize the passing of the old regime. This change in the attitude of supervision was, in most instances, not engendered by any emotional wave of sympathy for the men in the ranks, but rather because of recognition of the fact that better results can be obtained by dealing with the human factor in industry on a more intelligent and scientific basis.

Whereas at the turn of the century attention was concentrated upon machinery, equipment and materials, and the importance of the human factor in production was largely overlooked; that attitude began to change when we entered the mass production period early in the century and the whole problem of production was subjected to scientific analysis.

In the past four decades an entirely new vocabulary has been developed, so far as industry is concerned. If anyone had used the expressions, "personnel administration" or "psychology and industrial efficiency" 40 years ago, they would hardly have been understood, at least so far as industry is concerned. Now personnel departments in industrial organizations are the rule rather than the exception. This has been reflected in the relation between the workers and the foremen, as well as between the foremen and the managements, and has developed an entirely new philosophy, so far as human relations in industry is concerned.

## Effect of Mass Production

This is not to be wondered at, when certain other facts are taken into consideration. Watts' steam engine was perfected in 1776, the same year in which the Declaration of Independence was signed. It was a long,

tedious process, however, to develop machine tools and facilities which would make possible the building of an efficient engine. Moreover, before it could be applied effectively in industrial operations, means of transportation has to be devised to afford economic justification for manufacturing plants of large size. Raw materials had to be brought to such plants, and ways and means had to be devised to distribute the products economically over wide areas.

It was not until well after the beginning of the present century that the more intense or mass production era began in this country. What that has meant in upsetting traditions and bringing about radical changes in our economic and social life may be partially gaged by the fact that according to a statement by President Karl T. Compton of the Massachusetts Institute of Technology, our productive capacity in this country has increased fifty times in the past four decades. Speaking before the Society for the Promotion of Engineering Education at its annual meeting last June, he said: "We know . . . that the people of the United States are served by the energy equivalent of 100 slaves working 12 hours a day for each man, woman and child, and that this achievement in energy production has been attained with amazing rapidity. At the turn of the century, the power used in this country was approximately equivalent to two man-power per capita."

One notable fact in the depression through which we have been passing is the emphasis that has been placed on research by industrial organizations. There is marked evidence of this in the locomotive boiler field, not only in better materials, but in design, the auxiliaries, and the methods of fabrication. Some of these improvements are now coming into general use.

### The Challenge

A two-fold problem and challenge, therefore, faces the supervisors in the locomotive boiler departments: (1) to keep in step with the demands being made upon them by the improvements in boiler construction and fabrication, and (2) to take advantage of the best thought and practices in the art of supervision. Of these two, the human relations problem is by no means the less important.

## The Work of the Bureau of Locomotive Inspection

**By J. M. Hall**

Chief Inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission

The basis of life on this continent is mass transportation, the sort of transportation that only the railroads are equipped to handle. No industry has contributed more to the advancement of civilization than the railroads, and you may take just pride in doing a man's share in this mighty task.

Boilers have often been referred to as the heart of the locomotive. It may not be amiss to refer to them as being the stomach as well because they take in and consume enormous quantities of fuel and water, much of which is converted into useful energy making possible the hauling of trains, light or heavy, fast or slow, as the nature of the service demands. The dependability of this service rests on your shoulders, but it may not be necessary to tell you this because you hear about it in no uncertain terms whenever one of your locomotives fails from any cause that may be within your control. Due to your skill and earnestness of purpose such failures are rare today. When we compare locomotive performance now with that of a comparatively few years ago we cannot help but marvel at the progress that has been made in the reliability of locomotive boilers and the manner in which they stand up to their task under today's grueling service.

In the early stages of enforcement of the Boiler Inspection Law, which was later amended to include the entire locomotive, opposition on the part of the railroads was often encountered. It is only fair to say, however, that it was usually found that this was largely due to lack of authority on the part of the local railroad officers to hold locomotives when they should be held for repairs, or lack of proper organization or necessary appropriation to properly perform the needed work, rather than to innate objection on the part of the mechanical officers to having their locomotives maintained in good condition. This situation became better as time went on as the railroads gradually came to realize that vast economies could be effected in maintenance costs through the medium of thorough inspections and timely and proper repairs and that true economy and promotion of safety by keeping their locomotives in serviceable condition go hand in hand. This changed attitude was contributed to in no small measure by your organization and by individual members thereof.

### Improvement in Condition of Boilers

The necessity for the law was brought about by the general practice on the part of the railroads of subordinating the making of needed repairs to the requirements of convenience. Practically all the large railroads had inspection and repair rules that were more or less adequate but these rules were generally considered as being merely expressions of desirable practices and little if any attempt was made to apply substantial repairs if any inconvenience would be caused thereby. As a consequence of this policy, ineffective or temporary repairs were often applied or the locomotives were continued in use with known existing defects until failures, many of which resulted in deaths or injuries, occurred.

Our early inspections disclosed that locomotive boilers were being operated with practically every defect that could exist in a neglected boiler.

During the first year there were three boiler shell explosions in which 27 persons were killed and 41 injured and 94 crown-sheet and firebox failures in which 54 persons were killed and 168 injured. The number of locomotives ordered withheld from service by our inspectors for necessary repairs was 3,377. In addition, 3,591 boilers were required to be strengthened or changed to comply with the requirements of the law and rules or permanently removed from service.

In 1938 there were five crown-sheet failures in which five persons were killed and three injured; the number of locomotives ordered withheld from service by our inspectors for all causes, including defects in machinery, was 679.

It might here be emphasized that the purpose of the law as expressed in the title is to promote the safety of employees and travelers upon railroads. To promote safety means to advance, extend, elevate, or contribute

to the growth of safety. This contemplates continuous progressive improvement; it calls for additions or changes whenever advancements may be made, and conversely, it prohibits the use of locomotives or parts thereof, or processes of assembly or repair which may be inferior, or upon which there is any doubt as to their being of at least equal integrity to practices already established.

### Responsibility

The locomotive inspection law and rules are very specific in placing responsibility upon the railroad company for safe construction, the making of inspections, and maintaining locomotives in proper condition and safe to operate without unnecessary peril to life or limb. Yet it is not uncommon to be asked by a responsible representative of a railroad company for acquiescence in the use of locomotives on his individual railroad of practices long recognized as unsafe.

Another procedure that is sometimes followed is to apply parts or appurtenances, or make repairs, in a manner that cannot be justified from the standpoint of safety, and then, after placing in service and having attention called to the condition, attempting to obtain rulings or interpretations that will permit use ostensibly within the legal requirements. Such attempts are usually accompanied by the pretext that it would be expensive to remove the locomotives from service and make changes, that the parts or appurtenances or method of repairs are less costly than recognized conventional standards, and by the suggestion, if not argument, that the changes are advancements in the art, when, in fact, similar, if not identical arrangements have long since proved themselves to be unsafe. We are not believers in the axiom that "there is nothing new under the sun," but it would seem that there is considerable truth in this old saying as such practices are indulged in not only by those who may have little knowledge of the ruggedness and dependability necessary to insure safety in railroad equipment and who probably are not familiar with what has heretofore been tried and discarded, but also by others who should be in a position to realize that attempts to use parts or appurtenances, that may reduce the degree of safety now afforded, are not in line with real progress.

### Progress—Or Safety?

Every generation has its own interpretation of progress. However, I am not sold on the idea that the desire to progress permits us to cut corners on matters of safety without giving due weight to the fact that taking a chance is keeping open house for death. The attitude of the Bureau of Locomotive Inspection is not ultra conservative; however, our responsibilities in seeing that the purpose of the law and rules is accomplished are too great to permit us to acquiesce in, or condone, the use of equipment that would reduce the degree of safety now afforded. There is danger in brushing aside things that have been proved in the past to be good and fundamental and seeking to adopt new, and in many cases, wholly untried ideas without need or justification. This is said with a full understanding that the trial and error method is the only means of bringing any new idea to perfection, but at the same time bearing in mind that most any new idea is susceptible to a calm analysis which will reveal its probabilities with respect to safety.

The duties imposed upon the railroads by the law are absolute and continuing. The fact that a Federal inspector has not taken exception to a condition, method of inspection, or method of repair, does not relieve the railroad from the responsibility placed upon it as clearly established by court decisions.

It is the purpose of the daily, monthly, and annual inspections required by the locomotive inspection law and rules to detect weaknesses that may have been unintentionally or thoughtlessly incorporated in construction or when making repairs, and to disclose deterioration that inevitably develops in service. If failures or train delays must be had, the proper place to have them is at the terminal where safe and economical repairs can be made.

The words, "economical repairs," are not here used in the sense of cheapness—there is no exemption from admission charges to the realm of dependable performance and service. However, there is a rebate on these charges that is recovered as time goes on. Economical repairs are substantial and consequently cost more money at the time they are applied than the inferior work that always accompanies cheapness. The difference resolves itself into the fact that economical repairs are in the long run low-cost repairs because they are lasting and pay a dividend in the shape of superior all-around performance, while inferior repairs result in consistently poor performance and are a continual source of expense and danger.

### Purpose of the Bureau's Work—Future Assistance by Master Boiler Makers

The Locomotive Inspection Law is humanitarian in its purpose; it was designed to conserve life and limb. There has been practically a steady reduction in the number of accidents, number of persons killed, and number injured, each year since the law became effective.

Bare statistics cannot, however, give an adequate picture of the human suffering that has been avoided through enforcement of the law. Perhaps I should not use the word "enforcement" in speaking to Master Boiler Makers because the word implies some element of compulsion and there has been little if any occasion so far as your members are concerned to use the punitive measures provided for in the law to obtain compliance; your cooperation has been of an order seldom received by the administrators of any law.

In addition to the humanitarian aspect the operation of the Locomotive Inspection Law has also had a far reaching economic effect since it served to bring to the railroads a realization that vast savings in the ultimate cost of repairs and in unit fuel consumption are made possible by maintaining their locomotives up to the standard contemplated by the law and rules.

The assistance that can be given by the Master Boiler Makers Association and its individual members in the future will, of necessity, be along the same general lines as that given in the past. Of course, each of you will continue to make intensive studies of your most pressing problems, discuss them with other members, and, if of sufficient general importance, the results of your studies and experiments will be presented at your conventions so that all may profit thereby. This is a real service as your published proceedings make your deliberations available to all who wish to profit by their contents, and as great confidence is placed in the recommendations of your association, care should be exercised in sponsoring only the best practices rather than proposals of debatable value, in order that the prestige of your organization may be maintained. Then, too, the inevitable fact should not be overlooked that in the natural course of events some of the men now under your jurisdiction will take your places and younger men will in turn take their places. The training of these men in proficiency and the upholding of the best traditions of your craft is part of your work and should be given your thoughtful attention.

# The Functions of the Federal Committee on Apprenticeship

**By M. M. Hanson**

Principal Field Representative, Federal Committee on Apprenticeship, United States Department of Labor

The preparation of skilled workers under sound standards of apprenticeship is one of the most important and significant problems facing management, labor and government. It is universally recognized that a skilled worker can be fully and properly developed only through actual performance of the work of the trade on the job. Therefore, if young workers are to receive adequate preparation in all of the processes of the trade, there must be standards established to serve as yardsticks covering all aspects of apprenticeship. These standards should be worked out with representatives of management and labor, with the assistance of federal and state labor departments.

During the past two or three years there have been a number of significant developments with respect to the preparation of skilled workers which has encouraged closer cooperation of labor and employers. These developments have also given state and federal labor departments responsibility for the establishment of apprenticeship labor standards.

Significant among developments is the acceptance by the U. S. Congress, the U. S. Office of Education and the U. S. Labor department of the principle that the promotion of labor standards of apprenticeship is a function of departments of labor. As a result, the work of the Federal Committee on Apprenticeship has been made a permanent activity of the U. S. Department of Labor. Paralleling this development, several states have enacted apprenticeship laws and other states have established state apprenticeship councils through appointment either by the governor or the commissioner of labor.

The federal committee set up committees on apprenticeship in each state which could issue wage exemptions to employers who wished to employ apprentices under standards adequate to safeguard the interests of the apprentices and the journeymen in the trades. The state committees on apprenticeship were composed of equal representation from labor and employers and representatives of state agencies interested in apprenticeship.

When the N. R. A. was declared unconstitutional all legal power of the federal and state committees on apprenticeship was removed. Since that time the federal committee and state agencies have proceeded with the development of apprenticeship on a voluntary basis.

## Responsibilities of Federal Agencies

As the Federal Committee on Apprenticeship proceeded with its promotional efforts with employees and employers, it was apparent that the labor standards and educational functions of apprenticeship were not clearly defined.

Today, as a result of close cooperation, the relationship of the U. S. Department of Labor and the U. S. Office of Education regarding the development of apprenticeship has been carefully worked out in a joint statement prepared by the two agencies and submitted to the United States Congress. The statement pointed out:

"It is clearly and officially recognized by the President, the Office of Education, the United States Department of Labor and the American Federation of Labor, and by various national associations of employers and state governments, that there are two distinct groups of responsibilities and functions in the promotion and subsequent operation of plans for apprentice training. One group deals with the apprentice as an employed worker—the conditions under which he works, his hours of work, his rates of pay, the length of his learning period, and the ratio of apprentices to journeymen so that overcrowding or shortage of skilled workers in the trades may be avoided in large part. The second group of responsibilities deals with the apprentice as a student—the related, technical and supplemental instruction needed to make him a proficient worker and the supervision and co-ordination of this instruction with his job experience.

"It has been amply demonstrated that the responsibilities in connection with the apprentice as an employed worker can best be carried on by the State labor department which is charged with the general responsibility of improving working conditions and fostering the well-being of the workers, and that the responsibilities in connection with the apprentice as a student can best be performed by the State board for vocational education. These state agencies in turn look to the United States Department of Labor and to the Office of Education for leadership and research and for the determination of national standards in their respective fields . . ."

The group of responsibilities dealing with the apprentice as an employed worker are the basis on which the Federal Committee on Apprenticeship is carrying on its work. These responsibilities are generally called labor standards of apprenticeship. The Congress of the United States accepted this view and enacted the Fitzgerald Act (Public 308) which made the work of the Federal Committee on Apprenticeship a permanent function of the Department of Labor.

## Duties of Committee

The Federal Committee on Apprenticeship acts as a policy recommending body. Members of the committee contribute their services without compensation. The work of the committee is carried on under the direction of the executive secretary, who has under him a limited staff of field men.

The functions of the committee are as follows: (a) To promote the adoption of labor standards necessary to safeguard the welfare of apprentices; (b) to extend the application of such standards by encouraging their inclusion in contracts of apprenticeship; (c) to bring together employers and employees for the formulation of standards of apprenticeship in their trade; (d) to cooperate with state agencies engaged in the formulation and the promotion of standards of apprenticeship; (e) to cooperate with the National Youth Administration, and with the office of education in services to apprentices; (f) to conduct research in various trades concerning the labor standards of apprenticeship and to publish information; (g) to act as a clearing house for information, so that national, state and local employers and labor organizations may benefit from the experience of similar groups in other sections of the country; and (h) to serve in a technical, consulting and advisory capacity to all agencies concerned with apprenticeship.

## Minimum Labor Standards of Apprenticeship

The basic minimum labor standards of the Federal Committee on Apprenticeship are all contained in its definition of apprentice which is as follows: The term,

"apprentice," shall mean a person at least 16 years of age who is covered by a written agreement with an employer, or with an association of employers or employees acting as agent for an employer, and approved by the State Apprenticeship Council or other established authority, which apprentice agreement provides for not less than 4,000 hours of reasonably continuous employment for such person, and for his participation in an approved schedule of work experience through employment and for at least 144 hours per year of related supplemental instruction.

The national standards negotiated so far grew out of the successful apprenticeship systems developed through the cooperation of local employer associations and labor unions. For example in Chicago, St. Louis and in many other cities throughout the country apprenticeship has been established for over 15 years. These local apprenticeship systems have served as experimental laboratories wherein workable procedures have been developed. The national standards are a national copy of the successful local apprenticeship systems which have existed for years.

### Apprenticeship for Railroad Boilermakers

With the foregoing discussion serving only as a background of information, I assume that one of the first questions you might ask is this: Is it worthwhile, is it possible, and is it necessary eventually to formulate and place in operation National Standards or a National System of Boiler Making Apprenticeship for the Railroads? That question can be answered in this manner. My observation of the railroad boiler-making trade, meager though it is, leads me to say that boilermaking is one of the oldest and most exacting of the skilled trades. Railroad boilermakers, skilled in all of the processes and divisions of their trade, are always needed. Regardless of the fact that some of the operations of the boilermaking trade are mechanized, there will always be a need for skilled craftsmen.

For many years, the railroads have developed all of their mechanics, including boilermakers, through apprenticeship. Therefore a vast amount of information exists regarding the conduct of apprenticeship in all of the railroad shop crafts, including boilermaking. Because of this background of facts regarding boilermaking apprenticeship, your association is in a position to contribute much toward the further development of apprenticeship.

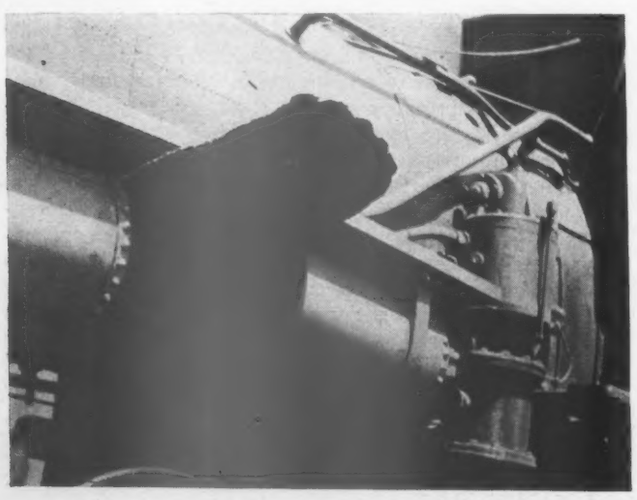
Since employers, labor, the federal government, and many of the states are cooperating effectively in placing apprenticeship on a more stable basis, it would appear that your association should examine the possibility of strengthening apprenticeship in your field of activity. What is needed, I believe, is a comprehensive study by your association of the problem of apprenticeship as it affects your members. I hope you find it advisable to conduct this study and report recommendations to your next convention. With the facts at hand, you can determine the extent to which apprenticeship should be emphasized as an activity of your association. The Federal Committee on Apprenticeship will be pleased to assist you in your efforts in any way you wish.

## Inspection, Testing, and Cleaning of Air Reservoirs

Committee recommends standard methods and is of the opinion the hammer test should be made every two years instead of every 18 months

The committee sent a questionnaire to the leading boiler men in this country and Canada. It has considered the varied practices and has based the report on the answers received with respect to the desired standard practice.

In a general discussion of the results of the survey, the committee recommended the use of a special extension light instead of a flashlight in the inspection of the reservoirs because it permits the actual condition of their interiors to be determined more accurately. It also stressed the importance of the proper size, type, and use of the hammer in the hammer test. The survey showed that the majority of the railroads removed the reservoirs for the hydrostatic and hammer tests. The committee reported that the majority of railroads specify copper-bearing metal for new reservoirs with longitudinal riveted seams and welded or spun semi-convex heads. A few railroads had reservoirs cast integral with the frame which, to date, had given satisfactory service.



**Defective air reservoir which failed at hydrostatic test due to deterioration of the sheets**

The committee made the following recommendations for the inspection, testing, and cleaning of air reservoirs:

*Inspection:* A daily inspection to see that the reservoirs are in good condition. An internal inspection to be made at hydrostatic and hammer test period using a special inspection light. If local conditions warrant, an internal inspection to be made at shorter intervals. A thorough inspection of the interior of the reservoir to be made at specified periods of the drum head, riveted seams, and for pitting and grooving.

*Testing:* Daily test by air inspector to see that reservoirs are in good condition. All reservoirs to be removed from locomotive for hydrostatic and hammer tests.

Use 1½-lb. ball pein hammer with medium blow for hammer testing. When applying hydrostatic test, drain cock to be opened to be sure that all air is released from reservoir before reaching the specified pressure. Hydrostatic test to be applied after 12 months service, provided

such service is performed within two consecutive years.

Hammer test to be applied every two years so date will coincide with hydrostatic test, caps, flues, and lagging. It is the desire of the committee to comment particularly on this recommendation. It is the consensus of opinion, considering the average life of reservoirs, being 15 to 20 years and that they are given an annual hydrostatic test, that it would not create a hazard to extend this text six months. The advantage would be to make the hammer test coincide with dates covering caps, flues and lagging. Reservoirs to be hammer tested before applying hydrostatic test, inasmuch as the hammer test may develop defects that would not appear under hydrostatic test.

*Cleaning*: Drain cocks to be opened daily or after each day's work, allowing all condensation and foreign matter to be drained or blown out. Reservoirs to be removed from locomotive at hydrostatic and hammer test periods to permit proper cleaning of interior. At enginehouses where cleaning vats are not available, reservoirs should be placed over pit, at an angle of 45 deg. and washed out with hot water using standard boiler washout nozzles. At backshops and larger enginehouses, reservoirs should be placed in cleaning vats with suitable solution for cleaning inside and outside of reservoirs.

This report was read by Chairman L. R. Haase, district boiler inspector, B. & O.

### Discussion

A. F. Stiglemeier, general boiler department foreman, New York Central, said their practice was to remove the head to make an interior inspection, after which the head is reapplied by riveting. He cited their experience of finding pitting and scale on the inside of the reservoir which was not indicated by a hammer test.

C. W. Buffington, general master boilermaker, Chesapeake and Ohio, however, made the statement that a good inspector can determine the condition of the reservoir by a hammer test without the added expense of removing the head.

F. Yochem, general boiler inspector, Missouri Pacific, spoke of the excessive hammering of reservoirs which made large dents and weakened them. He was of the opinion that better judgment could be used in making the hammer test.

M. V. Milton, chief boiler inspector, Canadian National, remarked that as the same conditions do not exist on all railroads, individual policy should determine whether it is necessary to remove the head in making an inspection of air reservoirs.

## Welding and Alloy Steel in Tender Cistern Construction

Reports indicate all-welded construction is satisfactory and that further experience is necessary to determine the value of alloy steel

The committee endeavored to secure all possible information from members of the association who have tenders of welded construction on the railroads which they represent. It does not feel justified in asking the association to adopt any type of construction or any grade of steel for tenders because the experience with welded construction is insufficient at this time to make definite recommendations. The committee presented reports from several members in order that the members of the association could be helped in forming their own conclusions.

### Report by A. W. Novak

We have in service 82 all-welded cisterns which are of the rectangular type with cast-steel water bottoms. These cisterns were built by the locomotive builders with the exception of 18 which we constructed in our own shops in 1929, 1930, 1931.

The cisterns, with the exception of six placed in service in 1938, were constructed of $\frac{5}{16}$-in. common tank steel. In the last six cisterns received ¼-in. Cor-Ten steel was used for roof sheets, coal-pit sheets, and all wash plates. Due to the inability to avoid distortion of the Cor-Ten plates, $\frac{5}{16}$-in. common tank steel was used for the sides and back wall which gave a better appearance.

Two months after 15 cisterns built in 1929 and 1930 were placed in service, cracks developed in a large number of the wash plates in each cistern. These cracks took place adjacent to the intermittent welds made at the ends of the plates and also in the exact center of the plates far removed from any weld.

The cracking which developed in these plates was directly due to the fact that no provision had been made to prevent the flexing or movement of the wash plates by the surging of the water. In view of this excessive cracking it was necessary that we make immediate repair. This was done by applying ⅜-in. by 3-in. by 3-in. T-iron stiffening to all of the wash plates, two such T-irons were applied the full length of each transverse and longitudinal plate, the T-irons being located one-third the distance from top and bottom of each plate. In an effort to learn whether the application of these T-irons would arrest the movement of the plate the cracks which existed were not welded, center marks were placed at each end of the cracks so as to learn if their progression had been stopped. These cracks were observed for a period of two years and in no instance was it noted that they had extended. As these engines were then coming into the shops for machinery repair, arrangement was made to have all cracks welded up. Since the T-iron stiffening was applied to the wash plates these engines have accumulated over 1,100,000 miles and no further repairs have been necessary.

The cisterns placed in service in 1931 were similar in design to those received in 1929 and 1930 with the exception that the wash boards had T-iron stiffening applied to them. The engines with these cisterns have accumulated over 1,000,000 miles since being received and there has been no cracking noted and no repairs have been necessary.

The 18 cisterns which were built in our own shops and placed in service in 1929, 1930 and 1931, were of the same design but of greater capacity than those previously referred to and T-iron stiffening was applied to all wash plates. The coal pit space in these cisterns was converted into an oil cistern. This arrangement presented an oil and water cistern being welded integral. The only cracking in these cisterns has been in the front sheet of the oil cistern which was caused by the vibration of an open-type oil heater set in the oil cistern. Additional stiffening was applied to this sheet and there has been no further trouble.

The cisterns placed in service in 1937 and 1938 have

given no trouble by cracking in the wash plates to date. The design of these cisterns was the same as the lot built by us and had stiffening applied to all of the wash plates. We have experienced some cracking in the plates forming the hot-well compartment for the feedwater heater and we have had to apply reinforcing to stop the cracking.

The cisterns placed in service in 1935, 1936 and 1938, were of practically the same design and had a wash-plate arrangement similar to our other welded cisterns. No bracing or stiffening was applied to any of the wash plates to reduce the total weight of cistern and in a further effort to reduce weight on the last six cisterns built in 1938, ¼-in Cor-Ten steel plates were used for all plates excepting the sides and back wall. A shielded arc of heavy coated electrode was used for all welds and the type of welds was the same as employed for all our welded cisterns. After two months of passenger service many of the wash plates in these cisterns were found to be cracked. The wash plates of Cor-Ten steel had cracked to a greater degree and cracks were of more irregular type indicating brittleness of the steel and greater damage caused by welding. It is necessary that we increase the weight of these cisterns by applying the necessary stiffening to all wash plates if cracking of these plates is to be stopped.

It is our opinion gained from our own experience that the all-welded cistern has considerable merit and is superior to the cistern of riveted construction providing consideration is given to properly stiffening the wash plates to prevent their movement or flexing by the surging of water. If this is done it is felt that the maintenance cost of the all-welded cistern will be negligible. The use of alloy steel for the sides and back wall of cisterns does not appear desirable unless some type of steel or method of welding can be found that will prevent the unsightly distortion. Light alloy steel plates can very possibly be used for the roof sheets, coal-space sheets and all wash plates and wherever sheet distortion is not objectionable. However, the thinner the wash plates are the more stiffening or bracing will be required to prevent their cracking. It is our opinion that thin plates of common tank-steel quality can be used equally as well as alloy-steel plates providing they receive a like arrangement of stiffening and should give better results as they are less affected by the welding process.

Pitting and corrosion has been eliminated in the interior of our cisterns that were built in 1929 and 1930 by the application of a rust preventative. The coal-space sheets and roof sheets which were coated several times have rusted some and become thinned, this however is due more to cinder cutting and coal wear than rusting. This type of wear will also take place with alloy steel plates. As we have only six engines where alloy steel has been used for the roof sheets, coal-space sheets, and wash plates, and as these have been in service less than a year we are unable to give any exact opinion as regards to pitting and corrosion of these sheets. We have mentioned that where the rust preventative applied on these sheets had come off some evidence of rusting is noted, but how extensive this will become we are unable to say at this time. We know of no alloy steel used in the construction of locomotive cisterns thus far that will absolutely resist pitting or corrosion; if such steel can be found it would not doubt prove very valuable.

### Report by B. C. King

Twelve locomotives built in 1930 have all-welded tanks with straight sides. T-irons applied horizontally on sides are welded to side sheet with continuous weld. These are the T-irons to which splash sheets are fastened. The tank sides are cracking at this weld. Ten locomotives built in 1934 having the flat-top semi-Vanderbilt tank have not given any trouble up to this time. Eleven locomotives built in 1938 of which three are oil burners, semi-Vanderbilt type have given no trouble so far, but all the oil tanks which are placed in the coal space have straight sides with T-irons applied horizontally on sides with continuous weld. The sides of these oil tanks cracked at the T-iron weld within six months after being received from builders. From this it appears that T-irons should be riveted in place of welding. We have had no pitting or corrosion in the tanks which have copper-bearing metals.

### Report by V. B. Vogel

By the use of all welded construction, the weight of our present cisterns could be reduced materially by the elimination of angle and T-irons. This alone, on large tanks ranging from 20,000 to 23,000 gallons, would be a reduction of weights amounting to 18,000 to 20,000 lb. This, and elimination of 1,500 lb. of rivets, as well as the use of a lighter gage metal of alloy steel with higher tensile strength would make it possible to reduce weight as much as 18 or 20 per cent.

The possibility of leaks developing after being put into actual service, would be reduced to a minimum and reduce cost of maintenance. The use of alloy steel, such as Cor-Ten, to resist corrosion and chemical action of water, would assure uninterrupted service of cisterns of welded construction. Welded construction makes it possible to build tanks of such design and shape to conform to the present trend to streamline.

The disadvantages, in my opinion, are largely imaginary and are the set ideas of men without a thorough knowledge of welded construction.

### Report by J. P. Powers

The Chicago & North Western purchased nine 4-6-4 locomotives early in 1938. These locomotives have the all-welded cisterns except for the swash plates, which are riveted. All plates used are carbon steel. These cisterns have given satisfactory service with practically no maintenance cost to date. The increased cost of alloy steel must be taken into consideration, and unless it is required to keep within certain weight limits and maintain water and fuel capacity, carbon steel can be successfully used by careful design.

Our experience with pitting and corrosion of locomotive cisterns shows that it is mostly due to ordinary rusting, particularly when the cistern is empty and stored for some length of time. On coal-fired locomotives, corrosion on the outside is due mostly to sulphuric acid from coal, cinders and moisture. Changes in operating conditions on many of the railroads now require locomotives to operate on long runs, and many locomotives are designed for this purpose with tenders large enough to eliminate stopping for coal and water. When designing locomotives for such purposes advantage can be taken by using alloy steel and welding in order to reduce weight.

### Report by S. A. Schickedanz

The use of welded structure eliminates, to a large extent, the fabrication of the material to be welded. It can be seen that elimination of angle connections, bolts and rivets will produce a reduction of weight of the finished product and the welded structure will be of equal or greater strength than the riveted or bolted structure.

Reduction of weight is also obtained by the use of high-tensile steel. However, it appears that several factors must be considered in doing this. Moving versus

static loads must be given consideration, also the fact that a liquid load in a cistern will produce entirely different stresses and conditions than the more solid loads. Theoretically, the advantages obtained by the use of alloy steel in the construction of tender tanks are: (a) The reduction of weight, (b) greater strength and, (c) greater corrosion resistance. As to greater corrosion resistance, the use of this grade of material has not been extended over a sufficient period to say definitely that an improvement has been effected. Since the yield point for alloy steel occurs at a higher unit stress than for carbon steel, it is evident that with the same factor of safety, a higher designing unit stress may be used, although care must be taken not to reduce the thickness of the plate to a point where it will be subject to undue deflection, which will result in ultimate cracks. The alternate is to provide additional stiffness, which offsets the saving in weight due to use of thinner plate and makes for more costly construction. Therefore in structures of this type the fatigue and endurance limit values are of great importance. The working unit stress should be based on the endurance limit when it is less than the yield strength of the steel.

Following are some experiences of two railroads with this type of construction which seem to substantiate or agree with above reasoning: One railroad advised the construction of 20 all-welded tender cisterns having a capacity of 26 tons of coal and 23,000 gallons of water, in which the principal sheets were 5/16-in. and 1/4-in. Cor-Ten steel with a saving of 7,147 lb. per tender compared with the tender of ordinary steel and riveted construction. This road built a similar tender except with principal sheets 1/4-in. and 3/16-in. Cor-Ten steel and all-welded construction. The saving in weight of this tender was 12,053 lb. The above tenders were built in 1936 and 1937 and so far there has been no difference in the maintenance nor in the character of service of the cistern with the thinner sheet than in the case of the tender with the heavier sheets.

Another railroad had some tenders of 20,000 gallons capacity and 25 tons of coal that weighed, ready for service 397,000 lb. and light weight of 180,400 lb. These tenders were equipped with cast-steel water bottoms and had tank quality steel cisterns. They built additional tenders same as above except with a reduction in weight in water bottom casting of 3,200 lb. The outer plates were of tank quality steel, and lighter gage alloy steel was used for splash plates and braces, accounting for a further reduction of 18,800 lb., or a total reduction in weight of tender of 22,000 lb., thereby reducing the ready-for-service weight from 397,000 lb. to 375,000 lb. In this case in less than one year in the lighter weight tenders, cracks are developing alongside of welds where flat plates are joined to angle or the iron braces. They are of the opinion that there is not sufficient stiffness in these plates to resist buckling and after applying sufficient strong backs or braces, the saving in weight will be greatly reduced. Of the two groups of tenders mentioned, the heavier one using tank steel throughout has given little or no trouble, while the lighter tender using lighter gage steels for interior parts of cisterns will require considerable reinforcing to prevent cracking of sheets. It was also noted that the cracks developed on the alloy steel sheets, none having occurred on the tank steel outer sheets.

A well-known locomotive designer expressed his opinion as not being in favor of what is ordinarily termed an all-welded construction. In all cases where the vertical T-iron was welded to the side of the tank and not riveted, the side sheet cracked just outside of the edge of the T-iron where the welding was done, no doubt, due to the unavoidable deflection of the sheet between the T-irons.

A number of cases have developed where all-welded construction has failed. In general it would seem that it is not advisable to raise the stress in alloy steel in proportion to the increase in yield point. As deflection is a function of the modulus of elasticity, and the modulus of elasticity of alloy steel is not far different from that of ordinary steel, it would seem that the proper procedure would be to take advantage of about one-half of the increase in yield point rather than attempting to go the whole way. For instance, if an ordinary tank with side sheets of 1/4-in. ordinary plate is satisfactory and an alloy steel with double the yield point were to be used, it would not seem sensible to assume that we could make the side sheet out of 1/8 plate; probably 3/16-in. would be satisfactory.

As to corrosion, information gathered from various sources seemed to indicate that copper-bearing open-hearth steel is practically as resistant to corrosion as alloy steel in this service. More study and tests seem necessary before it can be definitely stated that lightweight high-tensile steel will be more resistant to corrosion than copper-bearing open-hearth steel when used in locomotive cisterns.

## Training Boilermaker Apprentices to Become Better Mechanics

### Committee report outlines program for developing boilermaker apprentices having a more thorough knowledge of boiler work

Those entering the field of boilermaking should be reliable characters of high ability, and the selection of the apprentice should be given first consideration. A prospective apprentice should be able to speak, read and write the English language with an appreciation for correctness. He should pass physical examination by a company doctor. He should be able to understand and apply the four methods of calculation of addition, subtraction, multiplication and division, in both fractions and decimals and pass an examination on these various phases of arithmetic before being permitted to enter on an apprenticeship.

Railroads in the past have had three classes of apprentices, regular, helper and special. An applicant for regular apprenticeship should be between 16 and 21 years of age and pass the regular entrance examination. If accepted, he should serve four years of 290 eight-hour days for each calendar year. An applicant for a helper apprenticeship should be a regular boilermaker helper with at least two years experience and between 21 and 30 years of age. In selecting helper apprentice, ability and seniority should govern. He should be required to pass the same entrance examination as the regular apprentice. Helper apprentices should serve three years of 290 days of 8 hours for each calendar year. A special apprentice should be selected from young men between 18 and 26

years of age who have had a technical education and they should serve three years of 290 days of 8 hours for each calendar year.

Each boy selected should be put on probation for the first six months of his apprenticeship. During this period the supervisor should study the boy as to his habits and general fitness for the trade he has chosen. An apprentice board consisting of the master mechanic, general foreman, erecting foreman, and apprentice instructor, should be set up. This board should meet at least once each month and discuss the progress the boy has made. If at the end of the probationary period the apprentice has shown no aptitude for learning the trade, he should not be retained.

There are two problems in the education of an apprentice; the learning of the trade proper, and the development of the apprentice's ability to use technical knowledge, so he may be a better asset to himself and to the railroad.

### Shop Training

The following is suggested as a tentative schedule of time to be spent by the apprentice in the various departments:

*Toolroom*: 1 month—General instructions on names and purposes for which tools are used and the grinding and sharpening of tools.

*Heating Rivets*: 2 months—Proper preparation and maintenance of fire bed of coal or coke, and the proper degree of heat for rivets in various types of work.

*Front End Work*: 1 month—Netting and self-cleaning front ends, preparation of details and assembling of dampers and deflector plates.

*Ash Pan*: 2 months—Constructing and fitting up pans, slides, doors, and operating rigging.

*Tank Shop*: 2 months—General construction of tanks, importance of watertight joints and security of braces and gussets, miscellaneous tank work, air reservoirs, track tanks, etc.

*Staybolts*: 3 months—Importance of good threads in reaming and tapping holes, measuring and applying staybolts.

*Riveting, Chipping, Calking*: 3 months—Reaming holes for riveting, properly ground chisels, proper angle of beveling, properly formed calking tool to insure not scoring or damaging the plate under the edge or splitting the sheet. Hammers, dolly bars, etc.

*Hand and Machine Flanging*: 3 months—Miscellaneous flanging, both hot and cold work.

*Enginehouse*: 3 months—General hot work, light repairs, inspection of boiler under steam for leaks, bulges, etc.

*Welding, Forge and Fusion*: 3 months—All types of welding and instructions as to which parts are permissible to weld and which are not.

*General Work*: 8 months—This to include boiler shop special work not specifically mentioned such as special emergency jobs which might come in, power plant or stationary boiler work, or equipment for cranes, pile drivers, etc.

*Inspecting*: 3 months—All apprentices should know the I. C. C. Boiler Inspection Rules and they should be given thorough instructions on methods of making interior inspection of sheets, braces, rivets, staybolts, etc., so that defects will be readily recognized; also exterior inspection, and inspection under hydraulic and steam pressure.

*Laying Out*: 4 months—Laying out all types of boiler sheets, both by development and by templets.

*Machine Work*: 2 months—General instructions on the operation of all boiler shop machines.

*Cabs*: 1 month—Getting out details and constructing cabs.

*Patching and Fitting Up*: 4 months—Boiler reinforcements meeting I. C. C. rules. All kinds of fitting-up work.

Special apprentices are trained in all branches of shop work. At the completion of their apprenticeship they are given opportunity to select the craft in which they desire employment. The first two years are spent in all branches of the shop. The last one or two years are spent in the craft in which the apprentice desires employment. As a general rule, the special apprentice chooses the machinist craft. It is reported one Southern road this year will employ eight special apprentices who, according to contract, will follow boiler maintenance the last two years of their apprenticeships.

### Technical Training

In regard to the second problem—the technical training should consist of studies in mathematics, mechanical drawing, mechanics, and some knowledge of geometry. The regular and helper apprentice should be required to attend the apprentice school two-hour periods two days each week. School is generally held after shop working hours with good results under the direct supervision of a competent apprentice school instructor.

Mechanical drawing should be taught each apprentice and he should, from such instruction, be able to lay out and build from blueprints a complete locomotive boiler of small size from scale. He should also be able to figure the safe working pressure of the various types of boilers, air reservoirs, and other pressure vessels.

In the last twenty-five years the art of acetylene and electric welding has been created and great progress has been made in many branches of these arts until today it is almost a requirement that a boilermaker and the boilermaker apprentice do welding with both these methods. No apprentice should be allowed to finish his trade and become a boilermaker without being qualified as a competent electric and acetylene welder. Where there are machines for testing the various kinds of welding, the apprentice should be able to weld test pieces and have them tested to determine his proficiency as a welder.

### Other Recommendations

The boys should be given a copy of the book of rules on safety, or if not available, they should be told and made to realize the importance of observing carefully at all times, the common rules of safety, and every precaution should be taken to impress on them the serious consequences which might result from carelessness in this respect. If it were possible we should have a monthly magazine devoted entirely to boilermaking in all of its many branches, such as we have had in years gone by when we had the monthly magazine called "Motive Power," which later became "The Boiler Maker." Many of the present-day layer-outs, boiler inspectors, and boiler foremen owe their present positions to the many things that they learned in these magazines.

The master boiler foreman can aid the apprentice instructor greatly by taking an active interest in the apprentices' advancement. Not only this, but our superintendent of motive power, when he visits such centers as have apprentice instructors, should endeavor as far as possible to call the apprentices together and give a talk that will encourage the apprentices to greater effort and make them feel that they are part of the railroad.

After four years training and instruction, the boys who are the most proficient and have shown the most aptitude and ability will be readily recognized and there will be no trouble making selection of the most competent

man to become a supervisor when there is a vacancy.

The report was read by Chairman A. T. Hunter, assistant general boiler inspector, Atchison, Topeka, and Santa Fe.

### Discussion

D. J. Sheehan, superintendent of motive power, Chicago and Eastern Illinois, said that he does expect all of his apprentices to be placed on jobs after they complete their training, but he feels that although the release of apprentice graduates will be his loss, the railroad industry somewhere is going to gain a good mechanic. He spoke of the necessity of not retaining boys who show little aptitude, and of the reluctance of supervisors to report boys who make unsatisfactory progress in their departments.

A. G. Turnbull, chief mechanical engineer, advisory mechanical committee, Chesapeake & Ohio, discussed the need of scheduled courses for apprentices. He said a well-rounded course should be given apprentices instead of training them in one direction. He urged the practice of keeping apprentices on work for which they had shown particular aptitude be discontinued.

D. J. Ellis, chief mechanical officer, Chesapeake & Ohio, said that the craft needs the youths more than they need the craft and, therefore, the railroads should consider seriously what it has to offer that will attract them to the boilermaking craft.

## Means for Improving the Circulation of Water in the Boiler

Boiler check location, feedwater temperature, firing practice, and devices in firebox are factors affecting the flow of water

Unless there is approximated a uniform temperature throughout the boiler, stresses and strains of a violent nature at many different points are set up, the results of which we see every day in leaking and broken staybolts, warped and cracked firebox sheets and deterioration of the water surfaces of the boiler in general.

In the study of this topic your committee has deemed it advisable to divide the question into several separate divisions for the purpose of consolidating and closely grouping opinions and avoiding duplications of ideas.

### Conditions Adversely Affecting Circulation

Almost without exception it seems to be the universal opinion that the primary factors causing poor locomotive boiler circulation do not involve so much the fundamental design of the present boiler, but rather results from: (a) the entrance and impingement of feedwater at low temperatures, (b) improper water conditions and, (c) poor firing practices.

More concentrated effort should be applied towards correcting low-temperature methods of feeding water to the boiler. It is commonly agreed that the only ideal condition in this respect would be for the feedwater to enter the boiler at approximately the working boiler-water temperature. Until such time as something similar to this can be accomplished, the use of exhaust-steam injectors, feedwater heaters, automatic live-steam valves, heat boosters, spray and mixing nozzles, etc., to increase the temperature of the injected feedwater before it comes in contact with the various internal parts of the boiler, and the syphon, circulator and arch tubes to forcibly drive the hotter water to the more remote parts of the boiler, is earnestly recommended to your consideration in trying to bring about the ideal of a continuous and steady flow of boiler water from the firebox to the front tube sheet and back again.

Chief among the secondary factors adversely affecting circulation is the accumulation of scale and sludge, resulting from water of poor boiler quality, which forms in the boiler and is deposited particularly at the forward end between the flues and tubes, thus preventing the incoming water from freely finding its proper circulatory path to the bottom of the shell and back to the firebox surfaces. Another secondary factor affecting circulation is the location on the boiler at which feed water is injected. Our survey would further indicate that circulation is greatly affected through poor valve setting, valve and piston blows, improper size exhaust nozzle and smoke stack, improperly drafted locomotives, and poor firing practices.

### Corrections to Present Boilers

With regard to the proper location of boiler checks, our survey indicates that all are in agreement that this is near the front end of the boiler, but there are some differences of opinion as to whether the correct point is at the top or side. From data received, it would seem that with the use of the top check, results have been most satisfactory. It is recommended that the water enter the boiler over a baffle plate or through a recently developed spray nozzle which spreads the water entering the boiler, thus helping to prevent the sludge and scale accumulations at this location and providing for a better condition in connection with the final contact between the two bodies of water of different temperatures. Two members of the committee report that in their experience when a change was made to a top delivery of water to the boiler, staybolt and side-sheet troubles were very materially reduced.

As to sludge and scale accumulations affecting free circulation, all agree that this condition is being successfully minimized through the use of boiler feedwater treatment, proper adherence to blowing schedules to keep the dissolved solids below the foaming level, and the regular washing out of the boiler. In connection with the accumulation of sludge at the front end between the flues, tubes and sheets, it has been suggested by two members that a blow-down arrangement be applied to the bottom of the first course adjacent to the front tube sheet to provide a means of cleaning such accumulations which have a tendency to slow circulation in this location.

A study of firing practices should be made, particularly at lay-over points and terminals, because at the time of the fire-up many of the destructive forces of expansion are brought into action. It has also been suggested that a further improvement can be made on grates used in locomotives equipped with a brick arch, that after the necessary per cent of grate opening has been determined, the grates be applied with that opening graduated from front to rear, arranging for from 30 to 50 per cent greater opening at the front than at the rear of the firebox so that the lesser openings would be at locations of the greatest draft, the distribution of the openings to be determined through proper tests.

It is generally believed that the use of firebox syphons and circulators as well as arch tubes do much towards increasing circulation in the boiler, as these devices, as previously stated, have a tendency to force the current of heated water to the forward end of the boiler where the great portion of our problems exist.

### Corrections in the Design of New Boilers

Last year we heard W. R. Hedeman of the B. & O., report on the wonderful results they had been obtaining from the use of their water-tube fireboxes. We have information from him that at present they have 12 such locomotives in service, which have accumulated an additional 678,000 miles since his last report, the total now being 4,678,000 miles of service since built, which naturally speaks for itself. He assures us that the service obtained from these locomotives has been very satisfactory, that with the rapid circulation with this type of firebox, interior barrel conditions have been materially improved. We believe this idea may be a partial solution to at least some of our problems, and in the design of any new locomotives it should be given careful consideration.

We have received a recommendation that the foundation ring be constructed considerably wider than at present in order to adequately accommodate blow-down systems that are generally applied with blow-down arrangement to the bottom of the first course. It is further stated that if the foundation rings were increased in width from the conventional 5.5 in. to a 7.5 in. width this would increase the water supply 36 per cent at the point mentioned and this should also be very beneficial in high temperature fireboxes. It has been recommended that superheater flues 3½ in. in diameter are not large enough to be practical on coal-burning locomotives, and it has also been suggested that superheater unit bands be so applied as to offer less resistance to the cinders and clinkers passing through the flues.

The committee believes that staybolt leakage is influenced very greatly by all the factors connected with circulation, which have been previously discussed. However, the committee also recommends that in the application of staybolts the best workmanship possible should be used. In that connection one of our members has made the claim that the practice of using a small button on the staybolt hammer, which drives the bolts first in the center, upsetting them through the sheet, and in a second operation using the ordinary flat button to lay up the edges of the bolts, has been very successful in improving staybolt conditions.

The report was read by Chairman C. A. Harper, general boiler inspector, Cleveland, Cincinnati, Chicago and St. Louis.

## Locating Height of Crown Sheet and Water-Level Indicating Devices

Committee recommends two methods, one for use with new boilers, other for locomotives receiving classified repairs

The application and maintenance of water columns, water gage glasses and gage cocks as referred to in this paper must meet all the requirements of the Interstate Commerce Commission, Bureau of Locomotive Inspection. Under these requirements the lowest gage cock and the lowest reading of water glasses must be not less than 3 in. above the highest point of the crown sheet.

From the information gathered by your committee we feel that either of the two methods described will prove satisfactory for locating the height of the crown sheet, water glasses and gage cocks, and we feel that when new boilers are built or existing boilers are given new fireboxes that method designated as No. 1 should be used, this method being the most accurate. For checking the height of crown sheet, water glasses, and gage cocks in the enginehouse or shop on classified repairs the method designated as No. 2 should be used.

After the boiler has been permanently attached to the frames and cylinders the frames should be leveled longitudinally and transversely. When leveling angles have been applied to the first and second barrel courses at the center line as shown in Fig. 1, notches are to be sawed in both brackets with the face *D* exactly level.

### Method No. 1

A test cock or stud hole is located in the top of the shell directly over the highest point of the crown sheet. The test cock or stud is removed as is any convenient stud in the back head that is well below the water line. A pipe nipple, threaded the same as the boiler stud and to which is attached a rubber hose having a tubular water glass in the free end and of sufficient length to reach the right and left sides of the boiler head, is inserted into the stud hole in the back head.

The boiler is then filled with water to well above the anticipated water line. A metal rod ¼ in. in diameter

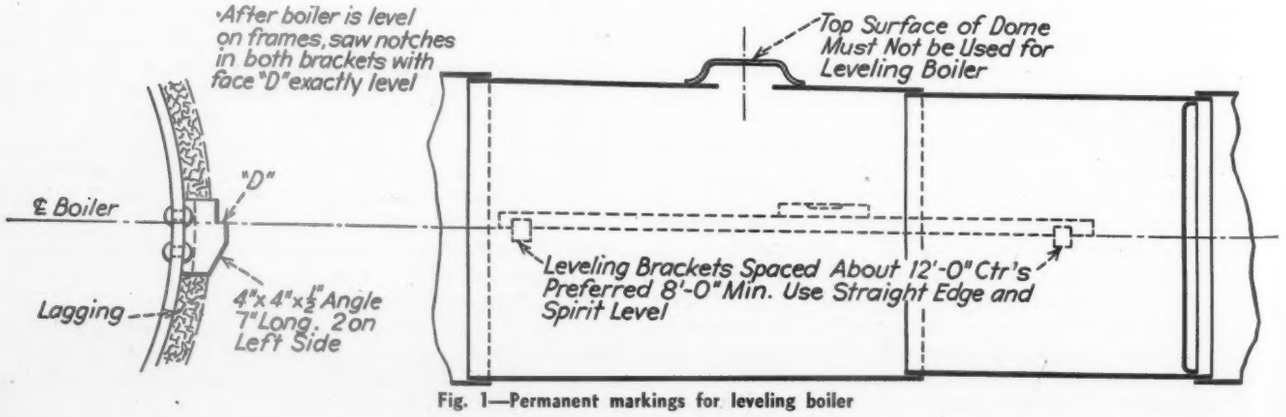

After boiler is level on frames, saw notches in both brackets with face "D" exactly level
Top Surface of Dome Must Not be Used for Leveling Boiler
℄ Boiler
"D"
Lagging
4"x 4"x½" Angle 7" Long. 2 on Left Side
Leveling Brackets Spaced About 12'-0" Ctr's Preferred 8'-0" Min. Use Straight Edge and Spirit Level

Fig. 1—Permanent markings for leveling boiler

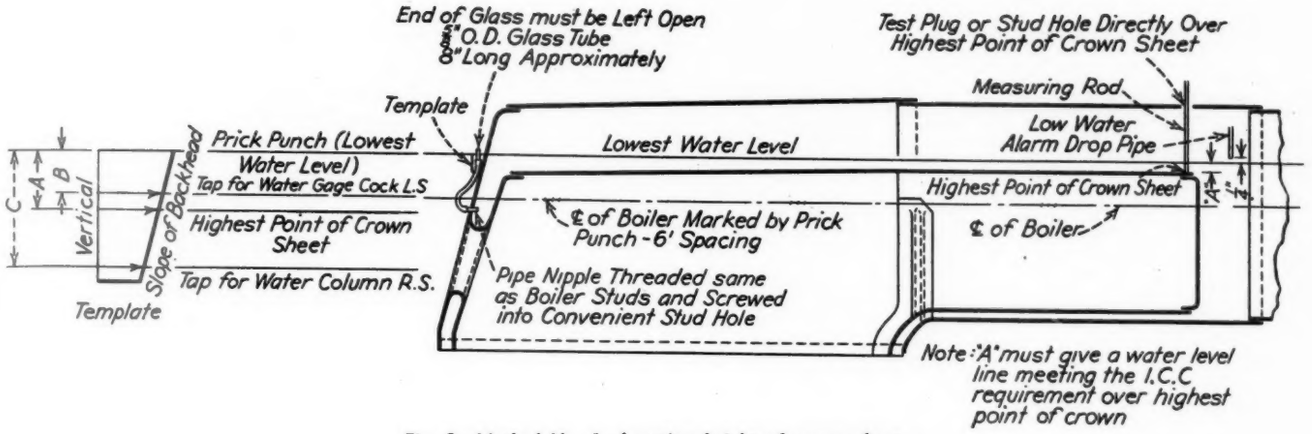



Fig. 2—Method No. 1—Locating height of crown sheet

is chalked and inserted into the test hole in the top of the shell and abutting on the crown sheet. The rod is withdrawn and the depth of the water noted. The water level is then lowered by opening a blow-off cock until the desired water level required to be carried above the highest point of the crown sheet is reached. Care must be exercised in inserting the measuring rod that it rests on the crown sheet and not on the flue sheet flange or rivet head. The free end of the hose with the water glass inserted in the end is held against the back head. Prick-punch marks corresponding to the water level in the glass are made on the right and left side of the back head so that a straight edge and spirit level can be used to check the transverse level and a line scribed across the back head to represent the lowest reading of the water-level indicating devices. Prick-punch marks and a line to mark the highest point of the crown sheet should then be made on the back head below the line of lowest water level; the distance of this line from the lowest water level line is to be the same as the height of water over the highest point of the crown sheet as shown by the chalked measuring rod. The location of the water-level indicating devices should then be laid out from the line marking the highest point of the crown sheet using a template similar to that shown in Fig. 2 and in accordance with the standard practice of the railroad.

### Method No. 2

A rubber hose should be provided which is long enough to reach from the front end of the firebox at the highest point to or above a corresponding height on the back head and having a tubular water glass inserted in each end of the hose with the exposed ends of the glasses ground irregular to permit the escape of air when the glass is held against the crown sheet. The hose should be blown through to assure its being free of obstructions and filled with water. Care should be taken that it is free from air pockets and that no kinks are formed in the hose. One end of the hose is taken into the firebox through the fire hole and the other end is held against the back head at the approximate height of the crown sheet. The glass in the firebox end of the hose is placed against the crown sheet at its highest point and the height of the other end of the hose is adjusted with the glass against the back head until the water is on a level with the top of the glass held against the front end of the crown sheet. The water level in the glass held against the back head is then marked on the back head in a sufficient number of places so that a straight edge and spirit level can be used to check the transverse level. A line is scribed across the back head the thickness of the crown sheet above the mark corresponding to the height of water in the glass held against the back head. This line represents the highest point of the crown sheet and is the base line from which measurements are made for application of the water-level indicating devices in accordance with the standard practice of the railroad.

### Locating Low-Water-Alarm Drop Pipe

After the pipe is installed the boiler should be leveled in the same manner as for locating the crown sheet height.

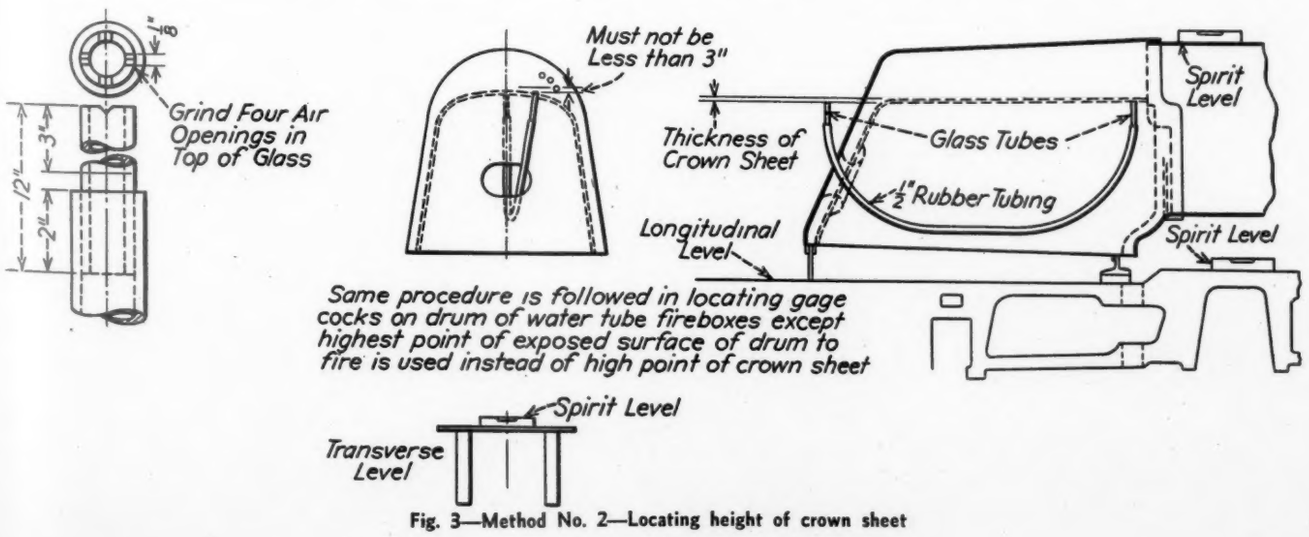
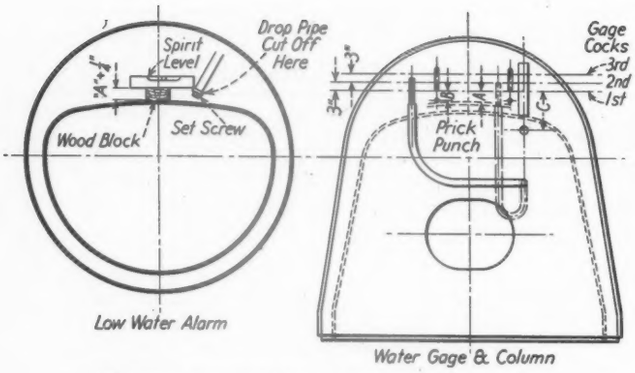



Fig. 3—Method No. 2—Locating height of crown sheet




*Water gages, gage cocks located and low water alarm drop cut off after boiler is mounted on frames with frames leveled and before engine is wheeled.*

**Fig. 4—Locating height of low-water-alarm drop pipe**

A wooden block 24 in. in length, having a parallel top surface and with the bottom surface cut to conform to the radius of the crown sheet, is placed transversely across the crown sheet at the highest point. This block should be so made that the approximate center of its length will contact the highest point of the crown sheet and the thickness of the block at the point of contact to the highest point of the crown sheet should equal the desired height of the drop pipe opening above the highest point of the crown sheet. The top of the block is then leveled crosswise of the boiler and the height is transferred to the drop pipe by means of a straight edge and spirit level. The pipe is then marked at the proper height and a ring gage is slipped over the pipe and secured by a set screw, the top surface of the ring gage being used as a guide for the saw in cutting off the pipe. Low-water-alarm drop pipes are usually on an angle of 25 deg. from the vertical and the cut should be made square with the pipe.

### Badge Plate and Crown-Sheet Marker

A metal badge plate showing the safe working steam pressure and having a line showing the highest point of the crown sheet should be securely attached to the boiler head. If the boiler head is lagged the jacket and lagging should be cut away so that the plate can be seen. The badge plate should be located as near the vertical center line as possible and should be so applied that the crown sheet line coincides with the height of the highest point of the crown sheet.

A metal bench mark should be securely attached to the boiler head opposite each water glass on a level with the center of the bottom gage cock and the lowest reading of the water glasses and project through the jacket not less than one inch. The purpose of the bench mark is to furnish a guide for the employees in replacing water gages and water columns in the enginehouse and shops.

After all the water-level indicating devices are applied the heights of the lowest indications should be checked by either of the methods described and it should be seen that the location of the lowest gage cock and the lowest readings of the water glasses coincides. The height of the crown sheet in a locomotive boiler cannot be termed as permanent due to service conditions and repairs, and while we have discussed the application of a crown-sheet badge plate to the back head, it is our recommendation that the crown-sheet height on all new locomotives be rechecked after 60 days service and also that the height of the lowest gage cock and lowest readings of the water glasses and the height of the low-water-alarm drop pipe above the highest point of the crown sheet be checked by the method for locating these parts after the application of a new back tube sheet or renewal of the firebox. Any differences found in these heights, from those previously existing, should be corrected.

The report was read by Chairman E. B. Gilley, general boiler foreman, Grand Trunk Western.

## The Longitudinal Cracking of Flues through the Beads

Committee report gives metal fatigue as primary cause, lists the contributing factors, and suggests possible remedies

The cracking of flues and tubes longitudinally through the bead is commonly called fire-cracked beads. It is our opinion the primary cause is metal fatigue. This metal fatigue, therefore, is the main problem and to prolong the life of the material and govern the amount of service we obtain from it before it reaches this fatigue limit, we must find and do all possible to correct the contributing causes, some of which we enumerate together with possible remedies:

### Expansion and Contraction

These are the stresses that actually produce the cracking after some or all of the other contributing causes have destroyed the ductility qualities, and set up strain hardening. As it is always present throughout the boiler from the time engine is fired until the fire is drawn and the boiler is cooled down, we should endeavor to control any drastic changes in temperatures during these operations. As the flues and tubes are of thinner material than the boiler or firebox plates, care should be exercised to prevent admittance of cold air to them by closing ashpan dampers, keeping the fire door closed, restrict use of blowers, and cover smoke stacks to insure against drastic contraction. Boilers should not be crowded and pressure raised too rapidly when firing them up.

### Excessively Large Beads

When too much stock is allowed for beading purposes resulting in large, high beads, the water back of flue sheet does not absorb the heat from the crown of beads fast enough, which results in an overheated condition of beads, destroying ductility.

Some roads have adopted the practice of counterboring their flue sheets, flaring and welding flues flush with face of sheet to keep all the metal as close to the body of water in the boiler as possible, with some success as a prevention for cracking. It is felt by designers and builders of locomotive boilers and different mechanical engineers contacted, that this practice should not be adopted in high-pressure boilers on account of taking too much cross-sectional area away from flue sheet and weakening bridges between the flue holes. The committee feels that $\frac{3}{16}$ in. to $\frac{1}{4}$ in. should be allowed for beading purposes.

### Water Conditions and Scale Formation

In nearly all cases where trouble is experienced with

fire-cracked beads, it is felt that formation of scale or deposits of mud at the back flue sheet is a large contributing factor. Deposits of mud or scale formation adhering to the flue sheet and flues restrict heat transfer and beads overheat under ordinary firebox temperatures.

It is obvious that the proper remedy for this condition is to treat the water, taking out the scale-forming solids. One remedy, which will prolong the life of beads, is to prosser the flues and tubes lightly at intervals to loosen this scale.

### Flue Bridge Design and Layout

It is felt by many, especially the boiler maintainers, that the engineer designing the boilers is too prone to obtain the greatest amount of flue gas area, sometimes crowding in flues till the water space between tubes and flues is too small and with a small accumulation of scale on the tubes and flues, circulation of water is restricted, heat is not absorbed fast enough, allowing the beads and flue ends to become overheated.

It would be our suggestion that consideration be given to spacing the flues in flue sheets with as liberal a bridge as possible, retaining as large a water wall as possible between the flues and tubes. Also, where possible to obtain sufficient flue-gas areas, flues and tubes should not be staggered so they cannot be readily washed out between the rows.

### Method of Application

It is generally felt that the conventional methods of setting the flues with sectional setting expanders, rolling, prossering, and beading does its bit toward the development of fire-cracked beads, in that these operations are all performed on the cold material and the cold working may produce tensional forces in the metal and certain cracking forces are present, before putting the flues or tubes in service after being applied.

Several practices have been established which, in most cases, contribute to lessening the fire cracking of beads. The following methods, as adopted, we consider to be especially helpful in that the cold working of material is reduced to a minimum and no doubt, some of the incipient cracks, not visible to the naked eye, prevented.

Making a corrugation, similar to the prosser crease in superheater flues, with a roller or corrugating machine while the flue is hot and being prepared for application is one method.

Another practice is that of flaring or belling the tubes with a flaring type roller instead of using the conventional flaring tool with air hammer or pining them over with a hand hammer.

Another one recently adopted, which looks promising, is the use of a type of roller expander which both rolls in the corrugation back of flue sheet and flares the tube preparatory to beading.

Some roads have discontinued the use of copper ferrules, it being thought eliminating the copper protruding through the flue sheet into the water space reduces the possibility of catching and holding the scale formation at the joint where flues or tubes enter the flue sheet and also because it is the practice of most railroads to seal weld the beads on initial application, it is thought a better job of autogenous welding is obtained. While this practice has its good qualities, the chairman of this committee has flues and tubes applied with and without copper ferrules and can see very little, if any, improvement in the fire cracking of beads.

### Method Employed in Safe Ending and Annealing

Another practice which appears to contribute to lessen the tendency for fire cracking is the method used in cutting tubing to length and for safe-ends. In some instances it was found that saw cutting was conducive to a greater amount of fire cracking due to the rough edge and the very small, minute cracks left in the end of the tube. The practice of cutting safe ends on a lathe and polishing the ends unequestionably greatly minimizes the danger of incipient cracks, which later open up in service.

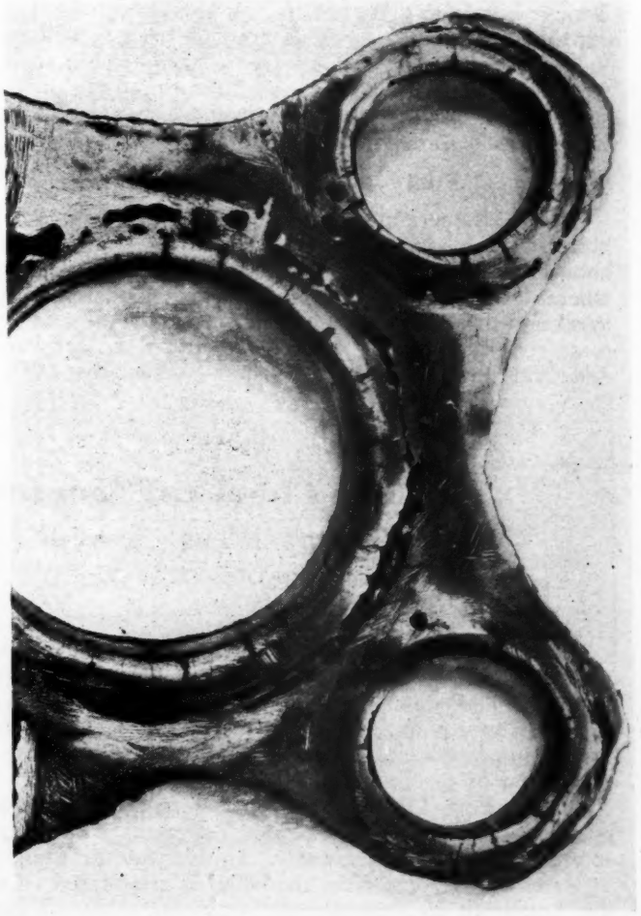
It is also felt that proper precautions are not always followed in annealing flues and tubes and that if more care were taken in heating the ends of flues and tubes to proper annealing heat and more precaution taken in protecting the ends from cold air or drafts, a more satisfactory service could be obtained.

It is suggested the proper heat for annealing purposes should be determined by the composition of the flues. With the ordinary standard steel flues and tubes, a medium cherry red, 1,250 deg. F., is considered proper.

### Electric Welding of Beads

There are many who feel that seal welding the flue and tube beads to flue sheet is largely responsible for fire cracking and we feel, that in many cases, it is. However, if all operations in connection with the flues and tubes are properly handled and performed, welding is no more responsible for fire cracking than any of the other causes.

If the copper ferrule is used and not set back the proper distance from face of flue sheet there is a great possibility of it becoming mixed with the weld metal, causing intergranular brittleness resulting in cracking of the flue bead. The remedy for this type of cracking is



**Fire cracks in flue and tube ends, firebox side, removed from a boiler having a working pressure of 300 lb. per sq. in. after 150,000 miles**

to set the copper ferrules back from the face of flue sheet for a distance of 1/32-in.

This is another reason why eliminating the copper ferrules is an advantage. If too much stock is allowed for beading purposes, you have already set up a cause for cracking, account of too much metal resulting in overheating and with the addition of welding material, the condition is aggravated. Smaller beads and just enough material for sealing purpose is the remedy.

In welding cold-worked material certain cracking forces are present in the tube metal before welding begins. These forces are the result of previous cold working such as rolling, beading and expanding. Cold working may produce tensional forces in the metal; then where a part of this metal is softened by welding, it is stretched apart by the tensional forces in the adjacent metal. Flues and tubes should be seal-welded with welding wire of 1/8-in. diameter to insure against excess metal being deposited. The kind of wire best suited for seal-welding is a matter of personal opinion, but we feel that a straight polarity wire should be used to keep the heating qualities as low as possible.

Care, also, should be exercised to see that flues, tubes and flue sheets are properly prepared. It is good practice to sand blast new sheets before applying flues to remove the mill scale. Old sheets should be ground off and be free from grease. The success of your welding depends largely on setting up a good, clean job to insure against an excessive amount of heat being used in the process of welding.

The practice of welding tube beads while the boiler is empty of water to prevent any abrupt temperature changes also seems to help in overcoming fire cracking. Tubes should be tightened by prossering with sectional expander, at intervals. This not only serves to loosen the scale and keep the mud from working back to the weld which causes an overheated condition, but it also serves by keeping flues tight to relieve to some extent the stress on the weld.

### Fuel and Honey-Combing

There are certain kinds of fuel which causes the honeycomb to form over and onto flue beads. This honeycomb adheres to the crown of flue beads and, where leakage is absent, is in a molten state. This overheats the beads causing them to feather out and become rough, producing a burnt condition of beads and destroying their ductility. Any improvement that can be made to reduce honeycomb forming will have its effect on prolonging the life of flue beads.

### Arch Setting and Drafting

Proper brick arch setting and drafting of locomotive boilers will tend to reduce fire-cracking of beads in that the gases passing over the arch will be evenly distributed over the entire flue area.

An arch so arranged or set in a firebox to cause the gases to concentrate over a certain area of flue sheet is similar to a blast and will overheat or burn flue beads.

### Firebox Temperatures

Uneven firebox temperature causes the unequal expansion and contraction of the portion of the flue directly in the back flue sheet while the bead is held firmly to the flue sheet by electric weld. Therefore, while engines are in service, every effort should be made to maintain the steam pressure constant. Reasonable care should also be taken in cooling the boiler gradually to as near the same temperature of washout water as possible before washing operations are started.

All the contributing causes enumerated and discussed do their part toward setting up conditions making it possible for the expansion and contraction stresses to bring about metal fatigue.

### Discussion

B. C. King, general boiler inspector, Northern Pacific, stated that tests have shown that the cracking of flues can be prevented by the proper treatment of the boiler feedwater.

L. R. Haase, district boiler inspector, Baltimore and Ohio, said high temperatures at the back flue sheet are responsible for the cracking of flues, and that this condition is not found where the heat is better distributed and not localized.

C. A. Harper, general boiler inspector, Cleveland, Cincinnati, Chicago and St. Louis, discussed the importance of the method used in cutting safe ends to eliminate the starting of checks, and of the beneficial results obtained by cutting them in a lathe although this method was more expensive than sawing.

A. F. Stiglmeier, general boiler department foreman, New York Central, however, said that while compression tests on safe ends that have been cut by sawing indicate checks are developed by this method of cutting, a saw in proper condition will eliminate this trouble.

## The Chemical Treatment of Boiler Feedwater

Committee report also indicates the importance of the proper blowing down and washing of boilers to control the concentration of dissolved solids

In introducing the reports of the other members of the committee, the chairman, C. W. Buffington, Chesapeake & Ohio, described the various methods of water treatment and pointed out that one of the biggest steps in the improvement of water conditions followed the realization of the importance of proper blowdowns.

On the Pere Marquette, Nalcometers are located at terminals and are used for rapid determination of dissolved products in boiler water. In this way the amount of water to be blown from the boiler is established. On the Louisville & Nashville the automatic blow-off has eliminated foaming. Wash-outs have been reduced from three- to eight-day periods to 30-day periods.

M. V. Milton presented the wash-out instructions used on the Canadian National.

F. Yochem of the Missouri Pacific recommended the elimination of the dome and the use of the perforated dry-pipe steam collector to reduce the heavy flow of steam into the dome.

Reports were included on this subject from M. Manley, for the Louisville & Nashville; R. W. Seniff for the Alton; A. D. O'Neill for the Pere Marquette; M. V. Milton for the Canadian National; F. Yochem for the Missouri Pacific, and E. Crapper for the Argentine Railways. The following is an abstract of the report from the Alton:

## Water Treatment on the Alton

Before 1921 there was one lime-soda water softening plant at Bloomington, then the most important and hardest water supply on the line. The remainder of the water was treated quite ineffectively with various forms of boiler compound. Most of them were essentially soda ash and, properly used, would have prevented scale and corrosion. The experiences on the Alton during those years have been the experiences of many who have attempted treatment with simple compounds including soda ash. It was a classical example of how not to treat water. Samples of scale removed from Alton boilers in 1921 are shown in Fig. 1 and some of the corrosion found on flues as well as some other parts of the boilers is illustrated by Fig. 2.

In 1922, Alton water treatment was organized on a systematic basis under the supervision of a chemical engineer and an assistant whose sole duties were improvement of locomotive boilers through water conditioning. Soda ash proportioning units were installed at practically every water station where non-carbonate hardness existed. For some reason unknown to the author, the lime-soda plant at Bloomington had been removed and soda ash only was substituted.

The fundamental principle involved in the treatment was that non-carbonate hardness was the chief offender in scale formation and if it were destroyed and precipi-

Fig. 1—Boiler scale—Inadequately supervised water treatment

tated as a non-adherent sludge by the use of soda ash, the carbonate hardness which is destroyed by heat alone, would also be precipitated in the boiler where both could be blown off as sludge. It is doubtful if the corrosion problem was given any serious consideration at that time.

The men in charge of the water treatment know that a chemical reaction is a definite and precise thing; that a definite amount of soda ash is required to destroy a given amount of non-carbonate hardness. They based their treatment on this fact, adhered to it, and it succeeded where previous attempts had failed.

During the years 1922 to 1927 there was a gradual improvement in boiler conditions but they did not improve as rapidly as they might have because corrosion continued at what seemed an accelerated rate. Boiler failures were practically eliminated during this period but maintenance, although reduced, still was rather high. By comparison with the period before 1922, conditions were considered good. The scale problem had been solved but the corrosion problem remained. During that period only slightly more soda ash than that needed to destroy the non-carbonate hardness had been used. Since the soda ash itself is destroyed when it reacts with the non-carbonate hardness, very little soda ash was left in the boiler water. At that time, this was thought proper

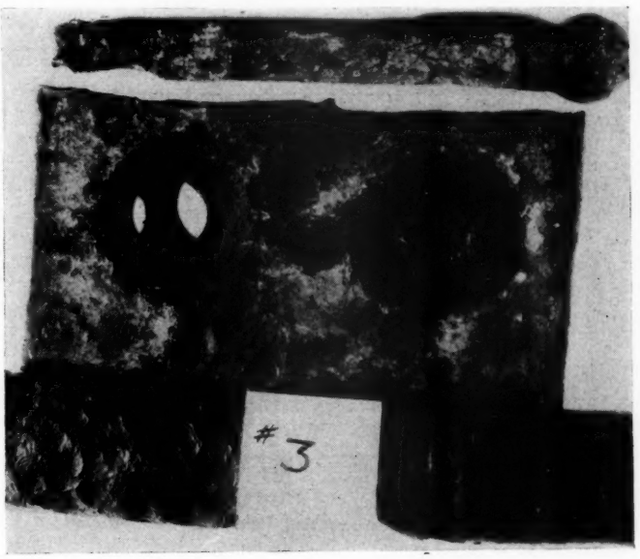



Fig. 2—Boiler corrosion—Inadequately supervised water treatment

because it was believed that excess soda ash had some mysterious effect of greatly increasing the foaming tendency of boiler water. Numerous service tests were made to determine the magnitude of this effect. Logically enough, but still much to our surprise, it was found that it had no more practical effect than boiler-water soluble solids already existing in the natural water supplies.

## Checking Corrosion

In 1927 it was decided to increase the amounts of soda ash added at points where passenger engines took water in order to secure a rather high excess of soda ash

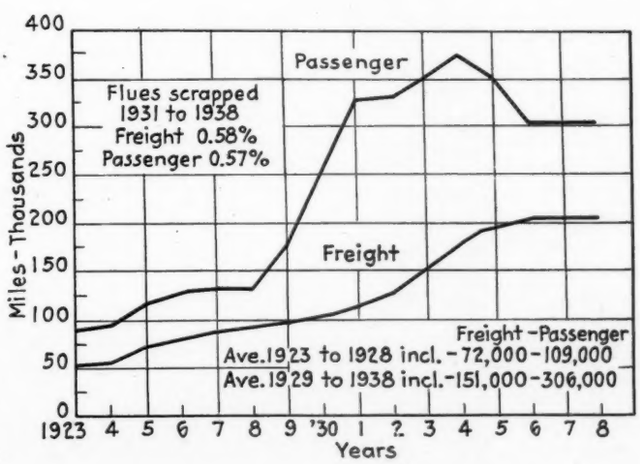



Fig. 3—Yearly average of locomotive miles between shopping for tubes

amounting to about 30 per cent of the soluble solids remaining in the boiler water after the non-carbonate hardness was destroyed. The purpose was to retard the

rate of boiler corrosion by increasing the alkalinity of the water in the boiler. Beneficial results were soon noticed and are clearly shown on the passenger engine graph, Fig. 3. The increased treatment was then extended to all water stations and the freight engine boilers also began to show the benefits. See the freight engine graph also shown on Fig. 3. These graphs show quite clearly how mileage between removal of flues was increased, first by the addition of only slightly more soda

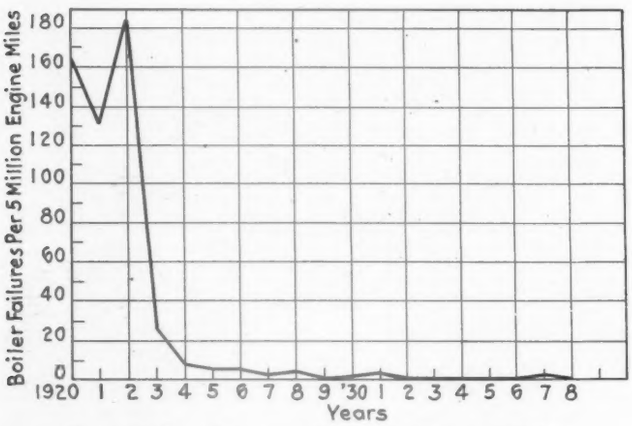



**Fig. 4—Boiler failures resulting from scale or corrosion**

ash than necessary to destroy the non-carbonate hardness and then later by the further addition of sufficient excess soda ash to give relatively high boiler-water alkalinities. The remarkably low percentage of flues lost because of corrosion is further evidence of the success of this procedure. It should be understood that the percentage of flues scrapped, shown on the graph, includes all flues at enginehouses as well as at the boiler shop at flue removal periods.

There was no increase in foaming trouble during this period; in fact this difficulty actually diminished. Some very interesting phenomena were discovered during an investigation of foaming tendencies during the years succeeding 1927 but their description does not properly belong in this report. One item only deserves mention here. Careful service tests have indicated that there is no difference in the foaming tendencies of the average water supplies between the Mississippi river and the Appalachian mountains in the northern half of the United States, whether treated with soda ash or limesoda, except in the case of sewage and excessive natural mud. In 1928, boiler washout periods at all points except one were extended to 30 days and a very definite improvement in boiler conditions resulted. There was a marked decrease in boiler cracking of all kinds and the boilers were also cleaner.

Eliminating boiler washouts to secure cleaner boilers seems like a contradiction but that is exactly what happened. The explanation is rather simple. The boiler water carries not only a considerable concentration of dissolved solids but also sludge. Some of both of these remains on the boiler surfaces as the water is drained out and, these surfaces being warm, dry off fast enough to leave this material adhering to them even though the washing is done according to the best practice with the least possible delay. Where a direct stream of water from the washout nozzle strikes this material most of it washes off, but in the other parts of the boiler it remains.

### Results of Treatment

The peak for passenger locomotive mileage between shopping for flues, as shown by Fig. 3, was reached in 1934. The limiting factor was the number of miles the locomotives could make in the period allowed on flues. The decrease in mileage between flue removals for passenger engines after 1934 is the result of limiting requests for Federal extensions of time to those flues which had not run more than 250,000 miles since application. Freight engine mileages, not affected by these limitations, continue to increase. Improvement in other boiler conditions kept pace with the improvement in flue conditions. The decrease in boiler failures is shown by Fig. 4. Firebox renewals decreased as shown by Fig. 5.

Federal extensions of time on flue removal dates made high flue mileages possible because on the Alton, 100,000 miles for a passenger engine and 50,000 miles for a freight engine per year is high. Since 1930, 139 first and 36 second extensions of time on flues have been granted. Thus in eight years, 175 years of flue service between removals have been gained. On the basis of locomotives owned (169 at the present time), this is equivalent to one full year of boiler service gained between shoppings in the eight-year period. On the mileage basis this amounts to over 5,000,000 miles gained. Sixty-five extensions were granted on Alton flues in 1933. Not a single extension request was refused. This was 5.07% of all extensions granted that year in the United States. According to the number of engines in service on the Alton compared with the total in service in the United States, this was about 16 times as many extensions as the average railroad in the country received that year. Not one of the engines on which the Alton requested an extension of time on flues had a single flue removed because of corrosion or scale.

A number of passenger engines have run between 400,000 and 500,000 miles between flue removals; one ran nearly 600,000. This was a Pacific-type engine carrying 220 lbs. per sq. in. steam pressure with 22-ft.

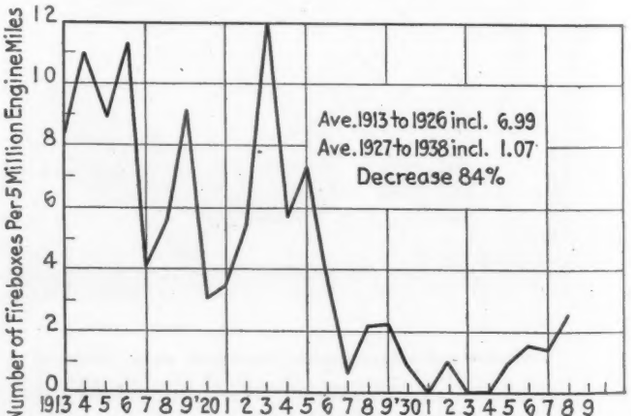

Number of Fireboxes Per 5 Million Engine Miles
12
10
8
6
4
2
0
Ave. 1913 to 1926 incl. 6.99
Ave. 1927 to 1938 incl. 1.07
Decrease 84%
1913 4 5 6 7 8 9 '20 1 2 3 4 5 6 7 8 9 '30 1 2 3 4 5 6 7 8 9
Years

**Fig. 5—Firebox renewals per five million locomotive miles**

flues. Its schedule was a round trip of 597 miles daily between Chicago and St. Louis. During the six-year period these flues were in service not a single one was removed because of corrosion or scale. Some idea of the condition of these flues and the firebox after running 598,000 miles can be gained from Fig. 6, showing the side sheet, and Fig. 7 the boiler interior looking forward The flues, when removed from this boiler, were found in such good condition that all were safe ended and reapplied. They have just completed an additional 400,000 miles, making practically a million miles in all. Samples taken from them were found to meet the American Society of Testing Materials specifications for physical tests for new tubes. It is interesting to note that boilers operating with 350 lb. steam pressure on the Alton Rail-

Fig. 6—Side sheet after 598,000 miles

road remain cleaner than those carrying 200 and 220 lb. pressure.

### Present Status of Treatment

Soda ash has been the only chemical used for prevention of boiler scale and corrosion. Since 1936, commercial tannin has been used at a few water stations to keep locomotive branch pipes and injectors clean. In 1938, Alton locomotives ran 6,049,000 miles using 1,179,000,000 gallons of water treated with a million pounds of soda ash. The cost of all items in connection with treatment was $0.02511 per 1,000 gallons.

Almost every railroad has a few points where water containing non-carbonate hardness is still used, where corrosion still gives trouble, and where cheap efficient treatment is desirable. Soda ash proportioning units are cheap, comparatively simple to operate and are easily moved in case of abandonment of water stations. Soda ash will give as satisfactory results as any other form of treatment, if correctly and judiciously used. The data presented in this paper are offered in support of this contention. It would seem that its use is indicated at water stations at which the water contains even relatively small amounts of non-carbonate hardness where: (a) Natural mud and sewage are not excessive; (b) financial considerations make more expensive treatment and treating plants undesirable, (c) especially at intermediate water stations now without treatment on

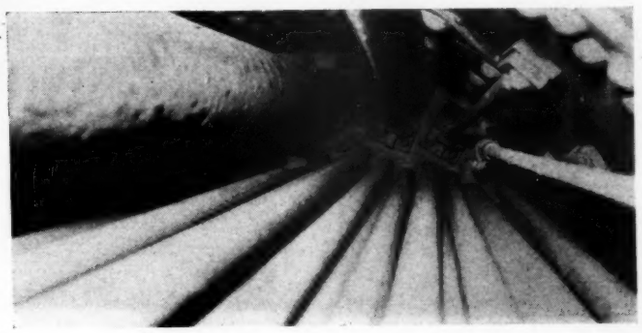
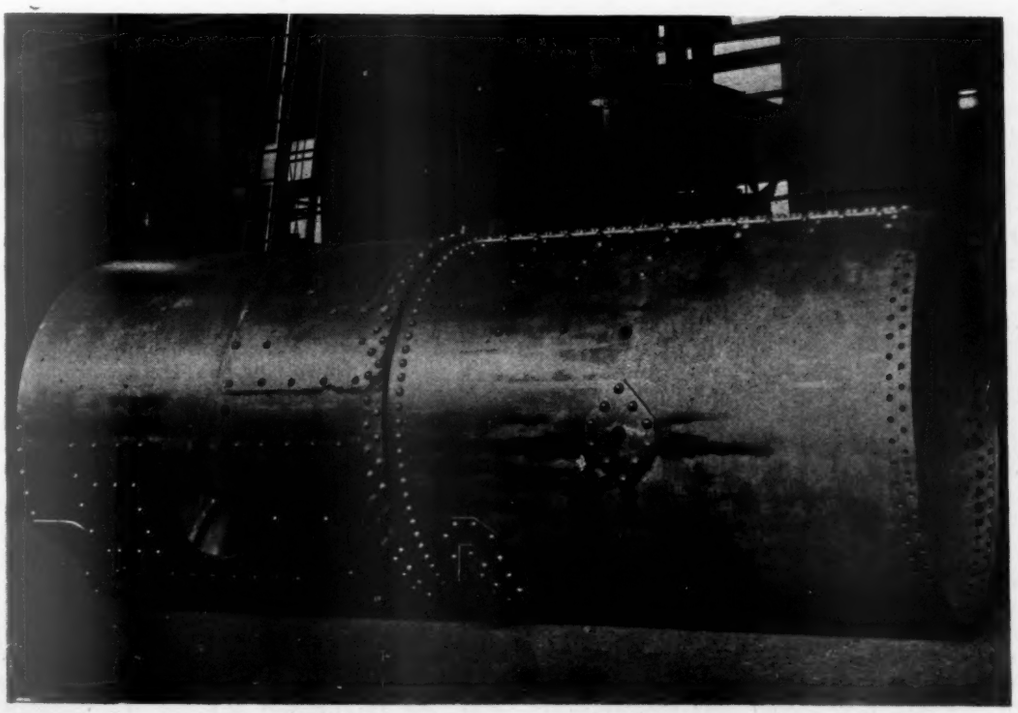


Fig. 7—Interior of boiler after 598,000 miles

divisions where the major water stations are already furnished treated water.

One absolutely necessary adjunct to successful water treatment is properly trained technical men. Unless the railroads are willing to assume the small proportional expense involved for such supervision, they should not expect optimum results.

* * *



W. E. Dunham
First Vice-President

C. J. Nelson, President

J. S. Acworth
Second Vice-President

**Meeting of**

# Car Department Officers

**Well-attended sessions of the association at Chicago hear constructive addresses and committee reports**

THE annual meeting of the Car Department Officers' Association, held at the Hotel Sherman, Chicago, October 17-19, was notable for excellent attendance and the generally constructive character of the individual addresses and committee reports presented. While the attendance at any of the sessions seldom exceeded 200, the total registration was 330, including both railroad and supply company members.

With President C. J. Nelson, superintendent, Chicago Car Interchange Bureau, presiding, the association was favored with individual addresses on foremen training, by L. W. Baldwin, chief executive officer, M. P.; the proper functioning and potential importance of the association, by F. G. Gurley, vice-president, Santa Fe, D. S. Ellis, chief mechanical officer, C. & O., and K. F. Nystrom, mechanical assistant to chief operating officer, Milwaukee; car conditions which need to be corrected, by D. J. Sheehan, superintendent motive power, C. & E. I.; the human factor in car work, by R. V. Wright, managing editor, Railway Age; the prevention of loss and damage, by C. H. Dietrich, executive vice-chairman, Freight Claim Division, A. A. R.; and private car operation, by Leroy Kramer, vice-president, General American Transportation Corporation.

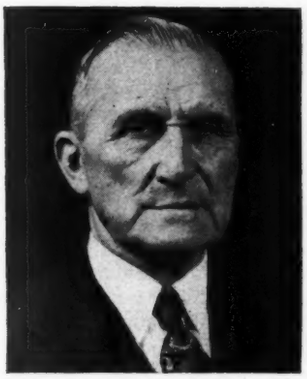
Committee reports were presented on the following subjects: Membership, Chairman J. S. Acworth, supervisor of equipment, General American Transportation Corporation, Chicago; Publicity, Chairman E. L. Woodward, western editor, *Railway Mechanical Engineer;* Freight and Passenger Car Construction and Maintenance, Chairman J. McMullen, superintendent car department, Erie, Cleveland, O.; Shop Operation, Facilities and Tools, Chairman J. A. Deppe, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.; Passenger Train Car Terminal Handling, Chairman G. R. Andersen, supervisor of car maintenance, Chicago & North Western, Chicago; Lubricants and Lubrication, Chairman J. R. Brooks, supervisor lubrication and supplies, Chesapeake & Ohio, Richmond, Va.; Freight Car Inspection and Preparation for Commodity Loading, Chairman F. G. Moody, master car builder, Northern Pacific, St. Paul, Minn.; Interchange, Chairman M. E. Fitzgerald, master car builder, Chicago & Eastern Illinois, Danville, Ill.; Loading Rules, Chairman H. H. Golden, supervisor, A. A. R. Interchange and Accounting, Louisville & Nashville, Louisville, Ky.; Billing for Car Repairs, Chairman D. E. Bell, A. A. R. instructor, Canadian National, Winnipeg, Man.; Painting, Chairman L. B. Jenson, passenger shop superintendent, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.; Nominating, Chairman J. E. Keegan, chief car inspector, Pennsylvania, Chicago.

### President Nelson's Address

Following the joint session address by L. W. Baldwin, as reported elsewhere in this issue, Mr. Nelson delivered his presidential address and emphasized among

A. J. Krueger
Third Vice-President

F. L. Kartheiser
Secretary-Treasurer



E. S. Smith
Fourth Vice-President

other things the possibility of large savings through more careful selection of cars for commodity loading, reduction of cross hauling, more effective and economical maintenance methods, increased knowledge of how to apply the highly important rules of interchange and loading, and the provision of equipment in better mechanical conditions to prevent loss and damage to freight. President Nelson called attention to the need for training younger men engaged in car department work and particularly developing an adequate force of experienced, competent supervisors to take charge of this important phase of railroad activities. He said that the association is national in scope and offers a common meeting ground for car men representing both the railroads and the private car companies, hence being adapted to develop constructive information regarding detailed car maintenance practices and problems not commonly considered by the Association of American Railroads, Mechanical Division.

F. G. Gurley said he was glad to offer every encouragement and assistance possible to the Car Department Officers' Association, both because of the desirable objectives of the association and because of the important part which members of the association play in efficient railroad operation. He referred to the vast improvement in car equipment from a maintenance standpoint, due to modern construction and said that the railroads now face the problem of satisfying more particular shippers who demand better cars and better service and who must be given what they want and made as "railroad-minded" as possible. In concluding his remarks, Mr. Gurley said that he was impressed with the frankness and fearlessness which the Car Department Officers' Association displays in discussing certain problems, a frankness and fearlessness not equalled or certainly not exceeded by any other organization. He urged the continuance of this characteristic if the association is to develop its maximum usefulness.

D. J. Sheehan called attention to a considerable number of specific instances in which desirable freight car maintenance standards, as well as A. A. R. loading and interchange rules are not being adhered to, with attendant serious increase in operating and repair costs, as well as loss and damage payments, not to mention dissatisfied shippers. He said that in the past two months thousands of freight cars have been returned to railroad service, many of them not being suitable for handling the commodities for which they were built, and cited, as instances, composite gondola cars offered for coal shipments with a high percentage of the side planks broken, flat cars placed for machinery loading with decks seriously defective, etc. He expressed the opinion that car department officers have a definite responsibility in keeping the general officers of their respective railroads acquainted with unsatisfactory car conditions. He said that they must be conscientious in their duties and have the courage of their convictions, not permitting cars to remain in service if unfit for loading and, by the same token, not marking any cars "bad order" which are fit to move commodities on the rails.

Mr. Sheehan closed his address with the following paragraph: "There is another responsibility which rests on the shoulders of car department officers and I believe this responsibility overshadows all others. The officers of the car department are charged with the responsibility of maintaining the rolling stock of the railroads in a safe condition to operate. When a passenger train leaves Chicago with its human cargo to go thundering at high speed over the rails, a car department officer, or one of his employees, is the last man to pass his approval on the safe condition of that equipment. When a freight train is made up at a terminal and before it starts on its journey through the night, a car department officer or his employees must know that the lives of those men who are operating that train, and the commodities carried, are properly protected in so far as equipment is concerned. . . ."

### Election of Officers

At the conclusion of the committee reports, the following officers were elected to supervise the affairs of the association during the ensuing year: President, J. S. Acworth, supervisor of equipment, General American Transportation Corporation; vice-president, A. J. Krueger, superintendent car department, New York, Chicago & St. Louis; vice-president, E. S. Smith, master car builder, Florida East Coast; vice-president, F. E. Cheshire, general car inspector, Missouri Pacific; vice-president, G. R. Andersen, supervisor of car maintenance, Chicago & North Western. F. L. Kartheiser, chief clerk-mechanical, Chicago, Burlington & Quincy, was re-elected secretary-treasurer. In accordance with the new constitution adopted by the association this year, retiring president C. J. Nelson, superintendent, Chicago Car Interchange Bureau, becomes chairman of the Board of Directors.

# Loss and Damage As Influenced by Car Condition

**By C. H. Dietrich**
Executive Vice-Chairman, A. A. R., Freight Claim Division

It is not possible from the statistics we gather to say which of the several principal defective conditions results in the greatest amount of damage, but we can say rather authoritatively that unless a car is proof against leakage from rain and snow storms, which necessitates a reasonably tight roof and snug fitting side doors, and is likewise free from contamination of grease, oil and other similar contaminating commodities, together with freedom from protruding nails and bolts, there is a great likelihood that damage to some extent will accrue to most classes of merchandise and freight loaded therein. Therefore, these three classes of defects may well be put on the car men's must list in his manual on what constitutes adequate equipment.

As an indication of what can be done along these lines I recently received a statement from one of the largest flour mill companies in the country on their 1938 experience, which shows that from all of their mills in the United States 96.5 per cent of the cars they loaded reached destination without damage, and at one particular mill during the month of September showed a record of 99.07 per cent of the cars loaded reached destination without damage. For the entire year of 1938 defective equipment is charged with $164,848 to flour and other mill products, indicating that all millers do not give the same attention to the equipment they load as does the one making this report.

## Large Claim Payments Due to Defective Equipment

In glancing through the year's summary it is rather surprising to note the cost of defective equipment furnished for loading coal and coke, which is ordinarily handled in open top equipment, on which claims to the extent of $193,667 accrued charged to this cause. The probability is that the greater part of this amount was chargeable to defective hoppers. The largest item in the account for 1938, so far as defective equipment is concerned, is that involving bulk grain, and here we have a loss and damage of $229,200 principally due to leaks through floors, sides, grain doors, etc. Getting down to defects more commonly associated with those mentioned above we find that sugar was damaged to the extent of $67,646 last year and this is divided equally between snagged sacks, damage account of wet from leaky roofs and contamination due to cars not having been properly cleaned.

The fruit, melon and vegetable group cost carriers approximately $100,000 account of defective equipment, and with the exception of watermelons I think it is a fair statement to make that the bulk of this damage is brought about because of improper refrigeration or protection against frost due to leaky car doors or ice plugs, that is, doors and ice plugs that do not fit snugly.

There is, perhaps, as you gentlemen know better than any other group of railroad men, a tremendous number of cars, both insulated and non-insulated, in service today that are not suitable for the loading of all commodities, and because of this situation there is a greater need than perhaps ever before for care in selecting cars for the commodity to be loaded. To what extent the car man can interest himself in this selection program, I am not sure, but I do believe it is a subject which you might with profit docket in order that the subject itself might be given the consideration due it by such organizations as has to do with this matter, particularly the Freight Station Section of the A. A. R., the Superintendents Association and any others that are responsible for the careful selection of equipment for the particular load intended.

## Improperly-Fitted Refrigerator Car Doors and Hatch Plugs

For the past several years, and at the present time, all lines engaged in handling fresh fruits, melons and vegetables in volume are being confronted with a growing number of claims for damage allegedly due to improperly refrigerated cars; the failure being charged to the fact that daylight is observed over or under the padded side doors or padded ice plugs. Our freight claim officers are inclined to challenge this complaint on the theory that any such infinitesimal amount of outside air seeping into cars through these openings could not possibly affect the inside temperature of cars. There is a great deal of expert opinion on the other side of this problem, and it is, therefore, quite important that this particular feature be given the attention of car men having to do with the maintenance of all insulated equipment.

Another very troublesome feature which perhaps does not run into extensive money damage, but does cause no end of controversy is the failure of many present day refrigerated cars to protect the contents against excessive cinders when shipments move under ventilation. In a long discussion with a large shipper recenfly the statement was made by him that there is a wide difference in the size of the mesh of screens placed in the car bunkers for the purpose of keeping out cinders. If this is true the carriers could save the payment of many claims, and especially the complaints from many claimants, by having these screens renewed with a mesh as small as possible without interfering with the ventilation qualities of the car.

With respect to the matter of damage associated with defective and inadequate running gear. This may not be the right designation, as I think the draft rigging is perhaps the most important part of a car so far as its relationship to damage to freight is concerned. To appreciate the importance of draft gear we must again refer to our statistical analysis of the loss and damage account from which it is observed that out of the 21½ million dollars expended in 1938, causes that have to some extent a close connection with the draft gear account for approximately 12 million dollars, or considerably more than one-half of the entire account. These causes are listed as unlocated damage together with improper handling in trains, yards or stations.

It is doubtful whether the average train man, whether he be employed in terminal or road haul work, has much detailed knowledge of the mechanisms of a draft gear, and especially is he in the dark on the fact that when the impact received in switching reaches four miles per hour, or thereabouts, even the most modern of our draft gears close and shocks in excess of this amount are taken with practically the same effect as though no draft gear protection was furnished at all.

## Prompt Repairs Are Essential

With further reference to the matter of damage associated with defective and inadequate running gear, I would be remiss in my duty if I failed to commend your

organization on what has been done during the past few years to overcome unnecessary delays to loaded cars through organizing at important terminals, particularly at interchange points, the prompt repair of cars that are cut out by inspectors in connection with rules governing the interchange of equipment. This, of course, is particularly applicable to carload shipments of perishable freight where failure to maintain schedules almost universally results in a claim for either deterioration or market decline.

There are many other angles to the relationship between loss and damage and equipment which my time will not permit an enlargement upon, but I will be more than satisfied if through this brief summary of the situation an active interest is initiated among the membership of your organization to the possibilities of the rank and file of your membership being in position to improve the services of the railroads, which serves a double purpose, i. e., satisfying patrons and is economical to the railroads through the prevention of loss and damage. There was never a time in our whole history when improved service and satisfied patrons was of greater importance than today due to the competitive forms of transportation we are undertaking to cope with.

## Report on Interchange

After careful consideration of many questions submitted, your committee makes the following recommendations for rule changes, or interpretations:

### A. A. R. Rule 3

*Question:* Referring to Rule 3, sec. (c), items (7), (8), and (9), do these paragraphs as now written prohibit the application of connections between the operating lever and the coupler, composed of links, clevices, etc., on cars built new or rebuilt after Aug. 1, 1933?

*Answer:* No. See Par. (8). However, we recommend that Par. (9) be revised to read: "Coupler operating LEVER of the rotating type handle (which pulls out and up through an arc, similar to type shown on Plate B of the United States Safety Appliance Specifications) AND connected direct with coupler lock or lift without the use of links, clevices, clevice pins, or chains, required on all cars built new or rebuilt on or after Aug. 1, 1933. From owners."

*Reason:* Note 1. The word "rigging" of old Sec. (9) is changed to "LEVER" to clarify, and our suggested change sets forth that the rule now clearly applies to the direct connections as well as the levers. Note 2. Plate B of USSA Specifications conflicts with current standards, inasmuch as it shows the use of clevices, clevice pins, and links, and further, the present rule does not cover cars built new or rebuilt after Aug. 1, 1933.

### A. A. R. Rule 4, Section (G), Item (3)

*Question:* Many cars reach interchange with side door operating levers, door guides, front and rear stops broken or missing, and many cards are being issued to cover where there is no associated door or car damage. Question arises as to whether or not these missing or broken door devices are damaged by unfair usage, or due to defective material or weak design of the particular device. What action should be taken?

*Answer:* Appreciating the difficulty at points of interchange, and in order to expedite movement of cars and eliminate carding, your committee recommends rule change as follows: "Rule 4, Sec. (g), Par. (3): Defect card shall not be required for damaged push pole pockets, door operating levers, stops (front or rear), or bottom guides, door hangers, or parts thereof, when not directly associated with other delivering line damage."

*Reason:* To eliminate excessive carding for such damage and expedite interchange.

### A. A. R. Rule 4, Par. (6)

*Question:* Having had so much trouble with the application of Rule 4, so far as it affects holes cut in cars for load securement in the past, and considering that the revision of Rule 4 as now proposed in Circular DV-952, dated 5-29-39, does not cover holes cut in sides or ends of composite cars, a specific provision should be made to cover, to eliminate delay and controversy at interchange.

*Answer:* Your committee concurs and recommends a new paragraph be added to Rule 4, as new Sec. (7), reading: "Wood sides or ends of gondola cars: Holes bored or cut exceeding 3 in. any direction."

*Reason:* To clarify rules.

### A. A. R. Rule 23, Section 111, Page 82

*Question:* A member submits request that the building up of axle collars be prohibited, and submits joint statements showing eight such built up axles removed from foreign cars, covering sixty days' period record, show edges of collars broken away and seams at bottom of collar fillets, and other conditions developed which warrant the elimination of authority to so build up axles.

*Answer:* Your committee recommends that the authority now granted in Rule 23, Sec. 111, be eliminated and provide that axle collars should not be built up by welding.

*Reason:* The information developed and presented indicates a dangerous condition, conducive of hot boxes and burnt off journals, which should not prevail.

### A. A. R. Rule 3, Item (11)

*Question:* In event a container car carrying a defect card, Rule 32 damage, is delivered in interchange with container missing, is such container cardable?

*Answer:* No. See Rule 32, Page 101, Interpretation Question 2. In such case car owner should trace for container.

### A. A. R. Rule 49, Location (D) Card Receptacle

*Question:* Considering the many new cars now going into service, and the hazard incident to locating defect card receptacles when placed under car, should we not suggest a definite location on the exterior of car?

*Answer:* Your committee recommends that the last sentence of Rule 49 be changed to read: "When receptacle is used, same must be in accordance with A. A. R. recommended practice specification, applied one per car, located on exterior of car, preferably under car numbers at B end, right side of car, not more than 5 ft. 6 in. from top of rail."

*Reason:* To expedite the inspection of cars at interchange points, and in the interest of safety of inspectors.

### A. A. R. Rule 58

*Question:* There seems to be a conflict as between Rule 3, Interpretation 4, Rule 58, and I. C. C. regula-

tions governing the interchange of cars. Can a loaded car be rejected if offered in interchange with end of train line broken off, angle cock and hose missing?

*Answer:* No. Repairs can and must be made without movement of car.

### A. A. R. Rule PC-7, Item (J)

*Question:* There seems to be an error in present rule, in that it is not definite in the provision as to what must be done with UC brake valve out of date.

*Answer:* Your committee agrees, and suggests that the words "must be cleaned" be added after the words "standard markings" in Sec. (j), first paragraph.

Last year the committee made certain recommendations pertaining to making greater efforts toward complying with regulations adopted by the Association of American Railroads, and as a reminder we would again urge that more care be exercised in connection with the following details:

1. Accept responsibility for fire damage, flood damage, clam shell damage, Rule 44 damage, etc., by attaching defect cards to cars at the time and place where such damage originates, and thereby saving time and delay at interchange points.

2. Attach defect cards to cars at interchange points, and refrain from running cars with delivering line defects on record, which results in misplaced responsibility, and which is contrary to the intention of the A. A. R. interchange rules.

3. Make greater efforts to prevent cars from which loads have been transferred account being in defective condition of the car, from continuing in service without repairing the defects which caused the transferring of the load.

4. Make greater efforts to repair cars for loading by thorough cleaning and removal of residue, including band wire, blocks, etc.

5. See that cars offered for loading are in suitable condition for the load of the particular commodity for which they have been ordered; also make greater efforts to insure that material being loaded in open top cars is secured in accordance with the A. A. R. Loading Rules.

The report of this committee, containing recommendations for considerations by the A. A. R. Mechanical Division was signed by Chairman M. E. Fitzgerald, master car builder, C. & E. I.; J. E. Mehan, assistant to superintendent car department, C. M. St. P. & P.; H. E. Wagner, division car foreman, M. P.; A. C. Browning, representative A. A. R. Mechanical Division; W. A. Emerson, general master car builder, E. J. & E.; E. G. Bishop, general car foreman, I. C.; F. McElroy, Union Tank Car Company.

### Discussion

[Rule changes or interpretations included in this report were approved by the association for submission to the A. A. R. Mechanical Division, with the exception of changes in three Rules No. 66, 68 and 84, which were either eliminated or deferred until next year's report. On account of space limitations, these three items are not included in the present abstract of the committee's report.—Editor.]

(*The committee report was accepted.*)

## Report on Car Construction and Maintenance

The committee, after reviewing the many details connected with our subject, has been unable to develop much that could be deemed of value to the association at this particular time; however, the following recommendations are submitted for consideration:

*Passenger Equipment:* It is recommended that overhead water tanks be equipped with standard connections to permit access to them from both sides of the train.

*Freight Equipment:* It is recommended that consideration be given to prohibiting in interchange cars equipped with push-down type release lever, known as the Carmer type, as it is our opinion that the above type of pin lifter contributes to break-in-twos of freight trains.

On some tank cars it is necessary to place the jack under the sills in order to jack them, which is not only dangerous, but requires considerable time to do the work. Suggest consideration be given to an additional allowance in price for jacking this type of car, also that future tank cars be constructed with outside jacking plate at body bolster.

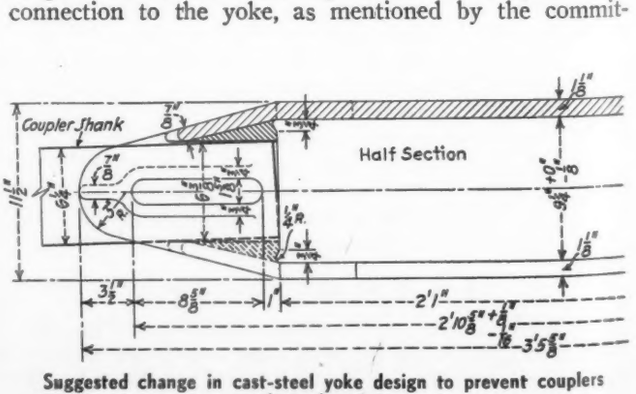
We continue to have trouble and complaints about drooping couplers. It is the opinion that this particular difficulty can be eliminated if the present type of cast steel yoke is changed so the butt of the coupler will shove into a pocket. There is considerable wear in draft keys, slots in center sills and the slot in the coupler, which allows coupler to droop, and it is the thought that if the yokes are made as shown in the drawing, the objectionable condition would be pretty well taken care of.

The report was signed by Chairman J. McMullen, superintendent car department, Erie; C. Claudy, master car builder, Grand Trunk Western; W. A. Bender, master car builder, Alton; J. R. Hayden, superintendent car department, Missouri-Kansas-Texas, and J. E. Keegan, chief car inspector, Pennsylvania.

### Discussion

With regard to the recommended provision of jacking plates at tank car body bolsters, one member called attention to the fact that these jacking plates are already called for in the specifications, and another member confirmed the committee's suggestion that it would be a good idea to allow an additional price for jacking tank cars by the more difficult and dangerous method of placing jacks under the sills when outside jacking plates are not provided.

A member from the C. B. & Q. said that the modern coupler is unbalanced and any slack in the coupler shank connection to the yoke, as mentioned by the commit-




**Suggested change in cast-steel yoke design to prevent couplers from drooping**

tee, tends to permit the coupler to hang down and create the hazard of a possible train break-in-two. He stated that once a coupler head starts to droop slightly, subsequent service shocks keep driving it down until a dangerous condition exists.

(*The report was accepted without recommendations.*)

## Billing for Car Repairs

The following is report of the Committee for Billing of Car Repairs, covering opinions of the members as expressed by replies received, as amended unanimously by the members present at the meeting held at Chicago, June 26th.

Some of the questions submitted to this committee have been referred to the Committee on Interchange, with such comments as represented the views of the members of this committee. It was felt that these questions were more properly subjects for the consideration of the interchange committee, and were such that their views might differ considerably from those of this committee.

*No. 1—Rule 3*: *Q.*—Would industrial and other non-interchangeable cars be exempted from the requirements of Sec. (b) (1)?

*A.*—Yes. Exemption from the requirements of Sec. (b) (2) would automatically cover Sec. (b) (1).

Rule 3 provides interchange cars built new on or after January 1, 1935, or rebuilt on or after August 1, 1937, must be equipped with No. 15 or No. 3 A. A. R. Standard brake beams. This rule also permits acceptance in interchange in initial movement from manufactured to destination of industrial or other cars not intended for interchange without meeting requirements of Rule 3.

*No. 2—Rule 8*: *Q.*—When repairs are made which are classed as temporary, is it necessary to furnish billing repair card when such repairs are not listed in Rule 108?

*A.*—Repair card must be furnished for all repairs made, except items listed in Rule 108, as outlined in first paragraph of Rule 8.

*No. 3—Rule 16, 3rd Par.*: *Q.*—While cars are stenciled "New Std" could car owner present claim for wrong repairs when repair card shows the former standard applied and removed?

*A.*—Yes, provided such claim was properly supported in accordance with requirements of interchange rules.

*Recommended*: that this paragraph be revised to provide for stenciling actual location of new standards.

*Reason*: If this is done the location at which new standards have been applied will be automatically protected against wrong repairs.

*No. 4—Rule 17 (C) (4)*: *Q.*—In the event of changing draft gear stenciling is it the intent that the actual type of gear will be stenciled, or the words "A. A. R. Approved?"

*Recommended*: that this paragraph be clarified to specify the stenciling to be applied when first application of A. A. R. approved gear is made to cars stenciled for draft gear. Would the words "A. A. R. Approved" suffice, or should the name and type of gear be stenciled on car?

*No. 5—Rule 23, Int. (3)*: *Q.*—Does this prohibition against changing coupler size or design by welding include welding plates to 8½ in. butts to bring them to 9⅛ in.?

*A.*—Yes. As the answer specifies that size or design of coupler cannot be changed by welding.

*No. 6—Rule 23, Int. (3)*: *Q.*—Can couplers with pieces welded to sides be arbitrarily scrapped at owner's expense if not otherwise defective?

*A.*—No.

*No. 7—Rule 32, Item (P) and Sec. (B) (3)*: *Q.*—Would safety appliances on tank cars damaged by operations covered by this item be owner's responsibility if car is not damaged to the extent shown in Rule 44?

*A.*—If car is not damaged to the extent shown in Rule 44 all defects (including safety appliance defects) would be owner's responsibility.

*No. 8—Rule 49, Sec. (A)*: *Q.*—In the event of a receptacle being R&R account other repairs, would it be satisfactory to re-apply it at same location when such location does not conform to Section (a)?

*Recommended:* That note be amended to specify procedure to be followed when receptacle is R&R on account of other repairs. Note in question now reads as follows:

"Suitable receptacle referred to above may not be initially to or relocated on foreign cars except with consent for car owner."

*No. 9—Rule 66, Item 12*: *Q.*—Does this mean that hollow or corrugated back wedges should be scrapped when found in foreign cars, irrespective of whether they can be condemned under Sec. (k) of this rule?

*Recommended:* That the first paragraph of this item specify whether or not such wedges can be arbitrarily scrapped at owner's expense. If they should be so scrapped, we also recommend that Rule 65 show whether or not owner can be billed for the replacement of such wedges when changed in conjunction with the renewal of wheels and axles for which the delivering company is responsible.

*No. 10—Rule 87, Sec. (D)*: *Q.*—Tank car running board is partially renewed and repair card shows 1½ in. thick applied, but does not show thickness of board removed. Owner claims withdrawal of charge on basis of 1¾ in. being proper repairs to comply with safety appliance regulations as per page 113 of the A. A. R. issue of U. S. Safety Appliances revised to January 1, 1935. Should repairing line withdraw its charge or should owner be required to furnish joint evidence to determine one or other of the following facts:

(1) That car was stenciled as built after May 1, 1917.

(2) That if car was stenciled as built prior to that date, the remainder of the running board was 1¾ in. thick.

(3) That 1½ in. was recorded on the repair card, while 1¾ in. was actual applied.

*A.*—Repair card in itself is not sufficient evidence of improper repairs, therefore claim of improper repairs must be supported by joint evidence executed in accordance with requirements of Interchange Rule 12.

*No. 11—Rule 107 and Note Following Item 14*: *Q.*—Can labor be charged for side bearings and center plates if material charge for bolster is made per item 188-B, Rule 101?

*A.*—No. Note following item 14 of Rule 107 applies only to cast steel bolsters. Item 188-B of Rule 101 covers a composite bolster and charge should be on weight basis, including weight of center plate and side bearings; no extra charge permissible for rivets securing these items.

*No. 12—Rule 107—2nd Note Following Item 48*: *Q.*—Does this apply to yoke support bolts or rivets, or

only to bolts and rivets which might have been removed in order to remove the long cross key irrespective of the yoke support?

*A.*—No. Only to the R&R or R of angle or plate used to prevent draft key from moving out of place.

*No. 13—Rule 108 (A):* Third item from the end of this section reads as follows: "Turnbuckles tightened (other than body truss rods)."

*Recommended:* That item covering turnbuckles be amended to permit labor charge for tightening anchor tank band turnbuckles in addition to body truss rod turnbuckles.

*Reason:* This is a substantial operation usually, for which labor should be allowed.

*No. 14—P. C. Rule 10, and Note After Item 5: Q.*—Is the Note under Sec. 5 intended to apply to all items in this rule?

*A.*—Yes.

*Recommended:* That note be relocated below item 6 to clarify the intent.

*No. 15—P. C. Rule 22: Q.*—Is it the intent of the second note at the end of this rule that forgings and iron or steel castings will be charged and credited on weight basis at the prices per pound in Rule 101?

*A.*—Yes, provided they do not come within the provisions of Rule 105.

*No. 16—P. C. Rule 22—4th Note on Page 317: Q.*—Can charge be made for repairing a passenger brake beam not RSS&T?

*A.*—Yes. Charge on basis of actual material applied less scrap credit at $0.005 per lb., plus actual labor for removing, repairing, and replacing beam.

The report was signed by Chairman D. E. Bell, A. A. R. instructor, C. N.; B. J. Jamison, assistant supervisor car inspection, Southern; R. W. Hollon, chief A. A. R. clerk, C. B. & Q.; E. S. Swift, assistant chief clerk, Wabash; W. E. Henley, general foreman car department, I. C.; and W. J. Burns, mechanical inspector, General American Transportation Corporation.

(*The report was accepted*)

# Private Car Operation Helps Railroads and Shippers

**By Leroy Kramer**

After explaining how private car companies happened to be developed and what functions they perform, Mr. Kramer closed his address with the following remarks:

Many times it has been claimed that the private car industry is a leech upon the railroads and that the service rendered by the private car companies could be better handled if operated directly by the roads.

Neither of such claims is, in my opinion, based upon a thorough knowledge or understanding of the subject. On the contrary, it is my opinion that the railroads could have saved a huge amount of investment and considerable yearly operating expenses, if they had not individually provided as many cars for themselves as they have in the past. It has been their practice to generally provide enough various types of cars to protect their maximum requirements. It would have been better if they had provided enough to protect their normal requirements but had allowed private car groups strategically situated to supply the excess requirements of certain classes of equipment to certain groups of roads whose seasonal needs did not conflict.

## Private Companies Reduce the Need for Surplus Car Equipment

Do not mistake this proposition as suggesting a national pooling of equipment. There are too many diverse types required in different parts of the country and too much inertia in the handling of large groups of equipment, to believe that any car economy would result from a national pool. On the other hand, if a few well-organized, well-run, financially-stable private car companies could supplement the railroad equipment in various districts during various seasons, it would reduce the need for some of the surplus requirements and would better serve the districts which could call upon these companies for their unusual demands.

Much of this type of private car operation, either by districts or by industries, is now undertaken by existing private car companies, some of them having been organized by the railroads themselves, to protect more adequately certain branches of their service. These same types of companies could have added box cars, stock cars, and open type equipment to their fleets and by reason of their closer contacts and knowledge of requirements in the various districts in which they operate, brought about an economy in the use of equipment not now possible.

The above thoughts have been expressed without any idea that they will be adopted but there is much food for thought at this time and in the future, if the railroads are to be brought to the most efficient operating degree. The last two decades have shown conclusively that the railroads no longer have a monopoly. There are other forms of transportation, and while I agree that these forms of transportation have been unduly subsidized by the public, yet I cannot believe that they are to be ignored or eliminated.

Thus it becomes incumbent upon railroad managements as a whole, to consider seriously any and every feature of their operating problems with the view of bringing about the most satisfactory, complete and economical service to their patrons. In this object there is no doubt but what the private car companies can be of tremendous benefit.

## Competition Causes Changes in Railroad Transportation Methods

Looking ahead, it is apparent that competing forms of transportation have imposed upon the railroads the necessity for changing their methods. All sorts of ideas have been presented, some of which are sound, but many are desperate attempts to "wish" traffic back on the railroads. This form of wishful thinking cannot accomplish results.

Referring to the high class merchandise freight which has so largely gone to the trucks, a survey was made in Chicago recently to determine whether those shippers now using trucks would go back to the railroads with equal rates and equal time of delivery. Over 200 shippers were contacted and in only one case did the shipper agree that he would return to the railroads on an equal basis. All the others said that either they must get better rates or better service before they will give up the convenience of trucks. Therefore, in this battle of highway transpor-

tation against railways, it is best to face the truth and I advise you car department officers to begin learning about the maintenance of trucks. Some railroads have already engaged in truck transportation and others have stock interest in trucking companies. The latter case is similar to certain railroads having stock interest in private car companies handling railroad cars. The effect is the same. In other words, the railroads are now giving the shipper what he wants and I can foresee a much increased co-ordination between the railways and highway transportation in the future.

The principal object of operating railroads is to make net earnings. If they can make money by the use of buses or trucks in co-ordination with rail service, it is time to use imagination and work out such a plan. For many years the word "transportation" referred almost exclusively to railroad transportation. Today it simply means getting products from one part of the country to another in the cheapest possible way. In the Railway Age of September 30, is the following pertinent statement. "The shipper diverts his goods from railroad to barge or truck—not because barges and trucks are less costly, but because they are less expensive (an important distinction)."

The private car industry today stands ready to give freely of its equipment, organization, engineering talent and imagination to provide better and cheaper ways for shippers to handle their products on the railroads.

## Report on Painting

During the past nine years we have witnessed a revolution in passenger-car painting. The advent of air conditioning in 1930 brought a new era of interior design and decoration made possible by the cleanliness resulting from this pressure ventilation. The installation of the first streamlined train in 1934 revolutionized the exterior painting of passenger cars and locomotives. Now this new era in painting is very important to the railroads. It is wielding a tremendous influence in renewing the interest of the American public in railway travel.

Today, the railroads are more than ever endeavoring to have their equipment meet with popular approval. In the past nine years more than 11,500 passenger coaches and Pullman cars have been equipped with air conditioning systems. During the years 1934 and 1938, 85 new streamlined trains were placed in service, and many more have been added this year. Tomorrow, if monetary factors are favorable, it is expected that not only will there be a marked stepping up in the purchase of new equipment of light-weight construction, but there will also be a marked increase in the rehabilitation of existing equipment.

This new era in painting has, of course, increased the work and responsibility of the painter and confronted him with many new problems. Not only has the entire scheme of painting been revolutionized, but the car builders have employed new metal and alloys and other materials that require different treatment and care than do the old ordinary steel and wood surfaces. Most of the roads have adopted their own individual outside color scheme for passenger cars, discarding the Pullman color that predominated for years. Today, we see red cars, gray ones, blue, green, yellow and nearly every color of the rainbow that will attract the eye. Due to high-speed, constant cleaning and the desire to keep the new trains in tip-top condition, means that they will be shopped oftener than is customary with the older cars. And shopping these trains presents problems because in many cases it will be hard to match the new colors or touch them up without creating a spotted leopard effect.

### Modern Bright Colors Introduce Problems

The new era of railroad painting has also made the passenger car cleaning problem more important than ever before. Trains with bright colors must be kept constantly spick-and-span or they lose their appeal. The washing of these new cars more frequently than was necessary with the older cars, will, of course, subject them to more abuse because washing tends to mar a car and destroy its finish. The problem therefore will be to keep the cars clean without harming their finish. In this connection, it seems that the old oxalic washing method will have to be discontinued because the streaks and burns caused by that material are more noticeable on the new era cars than on the older cars. Undoubtedly, the manufacturers, painters and chemists will eventually find a harmless substitute for oxalic acid.

That the railroads fully appreciate the importance of properly decorating and painting their equipment is apparent. Few new passenger-carrying cars are turned out today, in the interior design of which competent talent in the interior decorators art is not consulted. However, while consultant designers have been utilized to good purpose, it is questionable whether the railroads are affording their own painters the opportunity to become properly acquainted and educated to meet the changing conditions in the painting field.

While consultant designers are valuable in injecting new ideas, and avoiding violations of good taste and the creation of depressing effects, it is the painter, after all, who does the actual work and who has to maintain the job throughout the years to come.

Many people, including some railroad officials, think of painting as a thing anyone can do—and almost everyone has tried. Real painting is an art, a business of high skill learned only after years of apprenticeship and practice. The reliable painter and decorator makes painting his life work; he knows the fundamentals of his profession, keeps abreast of modern methods and is acquainted with the modern paints and decorative materials which are the proud achievement of American chemistry and mechanical production.

### Railway Equipment Painting Supervision Trends Downward

While the status of painters in general throughout the country has tended to rise during the past few years, railway equipment painting seemingly has headed downward, especially on certain railroads. On some railways the painting department has lost its identity, the work rightfully belonging to master painters is being handled, or rather attempts are being made to handle it, by men who don't know even the fundamentals of painting. Master painters who formerly attended meetings and exchanged ideas with other master painters to the benefit of all, are now conspicuous by their absence. While undoubtedly much of this downward trend in the supervision of railway painting is chargeable to the depression, there still remains the thought that some of it is due to the lack of proper understanding on the part of rail-

road executives as to the importance of painting. That railroad painting supervision should be allowed to deteriorate during this new and important era in equipment painting is queer to say the least.

In the matter of ordinary house painting, conditions became so bad that painters license laws were passed during recent years in at least five states. It was found that every Tom, Dick and Harry who owned a brush, wheelbarrow and step ladder was a painter contractor, doing inferior work, using imitation paints, gasoline instead of oil or turpentine, and doing the whole job cheap. Only it happened that home-owners didn't find such jobs very cheap after all. To remedy such conditions, Wisconsin, for example, requires contractors and painters to be licensed, and they must pass an examination before their license is granted. Furthermore, if inferior work is done by a licensed painter, or if poor material is used, a home-owner reports to the state inspector who can revoke the contractor's license, compel him to do the job over, or he gets no pay for the original work. Consider this protection for home-owners and then think of the protection that a railroad will get that belittles and ignores its painting department. You will naturally expect that the painting work on such railroads will be poor and costly.

### Twelve Million Dollars Worth of Paint in 1938

The painting bill on railroads runs into large sums of money. The Class I railroads of the country in 1938 purchased over twelve million dollars worth of paint and allied materials. And 1938 was a year of very low purchases. On one railroad it was found that in the shopping of 846 passenger-train cars during the three years 1936 to 1938, painting work took 17 per cent of the total direct labor and material cost of the repairs. This same road in 1938 spent over a quarter of a million dollars in direct labor only to clean its passenger cars at terminals. Isn't it evident from these figures that the painter is responsible for the wise spending of large sums of money? Isn't it apparent that he can be the cause through ignorance of the hidden waste of large sums?

Railroads are constantly being confronted with painting problems that tax the ability and ingenuity both of the painter and the chemist. Recently certain coast-line passenger cars on The Milwaukee Road developed reddish brown streaks in their outside finish, that progressed diagonally from the lower forward corner of the windows and below the felt rail. After considerable study and many tests, the cause of these streaks was determined. The discharge from the alkali blow-off of the locomotive condensed on the sides of the cars particularly along the windows. This dissolved the iron compounds, mostly iron oxalate, which had been formed by oxalic acid seepage around the brass and steel windows from previous washings of the cars. When the accumulation reached a sufficient quantity it was thrown out alongside of the car in streaks. The tests also showed the necessity of using alkali resistant varnish on the exterior of Milwaukee Road cars. The foregoing is a splendid example of the need for close co-operation between the railroad painter and the chemist.

In the foregoing paragraphs I have tried to point out the importance of railroad painting with the hopes that railroad officials will understand and appreciate its importance, and endeavor to build up, rather than tear down, the painting organization on their roads. Needless to say, a well-organized and properly conducted painting department is in a position to save a railroad much money, and enable it to maintain its equipment in the condition the public wants and expects. Many of the traveling public today regard an unsightly passenger car as being unsafe, which is certainly a poor advertisement for railroads which are constantly advertising safety first.

The report was presented by L. B. Jensen, passenger shop superintendent, C. M. St. P. & P.

### Discussion

While little time was available for the discussion of this report, the consensus was that, in view of the importance of utilizing the most efficient methods in painting railway equipment and the growing responsibility which rests upon painting supervisors, the association should lend them every encouragement to attend and participate in its annual meetings, until such time as a separate group or organization can be formed to consider exclusively the technical problems of paint materials and their application.

(*The report was ordered printed in the minutes.*)

## Shop Operation, Facilities and Tools

In its report for the year 1938 your committee dealt briefly on the subject, Facilities for Freight Car Repair Shops, and in this report we desire to submit, for your consideration, our recommendations covering the facilities and practices relating to the operation of shops handling the machining of wheels and axles.

At the outset your committee wishes to dwell somewhat on facilities which would be considered for the successful and economical handling of this important phase of car maintenance.

The size and location of the shop is naturally dependent on the amount of equipment required to turn out the quantity of wheels and axles needed to supply the requirements. On some railroads, where work of this class is carried on at more than one shop point, it may be found economical to concentrate the work by centering it at a lesser number of shops, preferably one shop.

Where the output of a wheel shop is sufficient to warrant the expenditure, the equipment should consist, aside from the necessary lathes for turning of axles, boring mills and wheel press, of a lathe used exclusively for rolling of journals. Such a machine will be found to result in saving of wear on axle lathes proper which occurs where the rolling of journals is done on the same lathe on which the machining is carried on. Also, it will be found that better workmanship and increased output will be obtained.

Your committee further recommends that where the operation is sufficient to warrant doing so, the dismounting of wheels be confined to a press used exclusively for such an operation as it will save the mounting press from the severe stresses caused by starting a wheel from the axle.

### Arrange Machines for Minimum Handling of Wheels and Axles

The arrangement of machines in a wheel shop should be such, as far as possible, as will permit of minimum

amount of handling of wheels and axles. The use of overhead cranes or electric hoists on mono-rails is advocated especially for the handling of axles to and from machines. The storage space for axles should preferably be where an overhead crane or mono-rail can be used to convey the material into shop with the least amount of travel. The rolling of loose wheels to and from machines is practiced in many of the wheel shops and as the men handling such work are usually expert, this method of handling is probably less costly than where other methods are resorted to. Likewise storage space for mounted wheels, both incoming and outgoing, must be provided for and where a dismounting press is used, same can be located so that mounted wheels can be handled from storage through the press, the wheels and axles, being sorted as to scrap or serviceable, and those fit for further service moved to storage spaces for later movement to shop for machining and regrinding.

A lathe for turning journals and axles without removal of wheels is a very useful machine and the average wheel shop should have such facility as it will save the expense of dismounting and remounting of wheels which would otherwise be necessary to permit truing journals of axle. Such a journal-truing lathe also allows for truing of journals when steel wheels are turned, insuring journals being in first-class condition when wheels are returned to service.

Greater use is being made of wheel-grinding machines, and economies can be effected where such machines are available. The grinding of cast iron wheels to eliminate slid-flat spots creates a considerable saving as the wheels would otherwise be scrapped. In the case of steel wheels a considerable saving in service can be made, not only in the grinding of wheels to remove the flat spots, but also in the case of steel wheels in passenger train service and where frequently because of the need for maintaining good riding qualities, it is necessary to remove wheels which have not been worn to the A. A. R. limits. In many cases of this kind, the tread contour can be restored without the necessity of grinding the flange.

The practice of grinding new steel wheels, as well as those which have been turned to restore flange and tread contour, is worthy of serious consideration as it insures such wheels being concentric which is something that is highly important when considering the riding qualities so much desired in passenger-train equipment. Moreover, the grinding of new cast iron wheels is a practice that is being considered more seriously and even being resorted to to some extent. There can be no doubt that concentric wheels will improve the riding of freight cars which is of definite importance especially with the increasingly higher speeds at which freight trains are being operated. There are wheel-grinding machines obtainable today which do all of this work very economically.

In connection with improved facilities for the turning out of wheels, the committee desires to call attention to the fact that some wheel-balancing machines are already in use. The balancing of wheels under motive power equipment of high-speed trains is being carried on to some extent and the time is undoubtedly close at hand when it will be considered equally important to balance wheels for service under passenger-train cars.

## Study Shows Many Wheel Shops Should Do Better Work

In this report your committee desires to call attention to the need for improving wheel shop practices, especially with regard to insuring better workmanship in the turning of axles, boring of wheels and mounting of same. If the procedure as outlined in the A. A. R. Wheel and Axle Manual is conscientiously followed, we can be sure of the work being performed satisfactorily. However, your committee has information covering a summary of conditions found within the last year at 76 various shops selected at random in which wheels and axles are machined and mounted, and out of all that number, 27 shops were classed as carrying out good practices and performing good workmanship; 13 of the shops were classed as doing fair work; 36 of the shops were classed as doing work which was in need of considerable improvement. Your committee does not have the information as to ownership of the shops covered by the report, but we have every reason to feel that the information was based on conditions as they were found. Without going into considerable detail it is thought that the members of the association would be interested in some of the extreme conditions found in the investigation, for instance:

Wheels bored 3/8 in. eccentric.
Wheels bored 1/8 in. diagonal.
Wheels bored .008 in. out of round.
Wheels bored .018 in. tapered.
Wheels fitted to axles where .027 in. smaller than the wheel seats.
Finish boring wheels to fit an axle with one cut through the bore.
Wheels finish bored by hand feed.
Boring bar .032 in. loose in the housing.
Wheels bored with common round-nose tool and adjusted with a hand hammer.
Wheel seats turned .008 in. out of round.
Wheel seats turned .022 in. tapered.
Journals being rolled that were not turned.
Mounting gage 21 years old.
Mounting gage 1/4 in. out of gage.
A difference of 20 tons pressure between the recording gage and the indicating gage (both on the same press).
Recording gage 50 tons light. (This gage not calibrated in 12 years.)
Recording gage charts with markings 1/4 in. wide.
Recording gage charts with wheel fits shown to be 2 in. long.
Pressing two wheels on one axle with one pressing.
Using 9/16 in. shims in boring mill jaws.
Mating wheels by calipering the treads instead of taping them.
Mounting wheels 5/8 in. out of gage.
Wheel press with a 14-in. ram and a recording gage for a press with a 9-in. ram (both on the same press).
Shops equipped with micrometers and the machine operators unable to use them.

It is obvious to your committee, as it should be to everyone having to do with the machining and mounting of wheels and axles, that discrepancies in practices and workmanship can creep in unless proper inspection and constant supervision is maintained. From the very nature of the inaccuracies referred to in the foregoing, it is quite evident that the maintenance of the lathes, boring mills and presses should be given careful consideration, and that such machines be inspected and checked frequently, especially where the finished work is found to be inaccurate.

The report was signed by Chairman J. A. Deppe, superintendent car department, C. M. St. P. & P.; J. H. Gimpel, assistant superintendent car department, Wabash; M. F. Covert, general superintendent equipment, General American Transportation Corporation; H. S. Keppelman, superintendent car department, Reading; P. B. Rogers, car shop superintendent, A. T. & S. F.; and P. F. Spangler, assistant superintendent motive power, St. L.-S. F.

## Discussion

J. M. Brophy, Illinois Central, said, and this opinion was confirmed by other members, that desired accuracy in wheel and axle work cannot be expected without keeping wheel shop machinery in excellent condition and that the individual machines should be checked by competent millwrights or machinists at periodical intervals, preferably not less frequent than once a month.

C. P. Ripley, representing the Technical Board, Wrought Steel Wheel Industry, said that the report is in line with the recommendations of the A. A. R., Mechanical Division Wheel Committee, and there is a gold mine for railroad men in checking the cost figures

for wheel service and making sure that potential service life is being secured.

With regard to the use of one wheel press exclusively for dismounting, Mr. Ripley said that, when this is not available, arrangements should be made to cut out the gage easily when pressing off wheels. Mr. Ripley said that turning lathes are the most important machines in the shop and that the men who operate them can save or lose a lot of money. He urged that lathe operators not be condemned too quickly for work which is not up to the desired standards, for in many cases they do not have the type of machine necessary to give these results.

Wheels must be truly round and mated. One precaution which Mr. Ripley said must be guarded against is the possibility of eccentric wheels due to excessive pressure of the driving dogs which cause the plates or axle to bend slightly. He said that one way to remedy this difficulty is to release the dog pressure slightly for the finishing cut, but grinding is a still better answer to the problem.

Mr. Ripley called attention to the need for a combination wheel lathe with accurate, heavy-duty grinding wheel attachments on the back which will permit turning and finish grinding a pair of wheels on one pair of centers without changing them from one machine to another. He said that wheels should preferably be mated within .005 in. to save flange wear; that the usual method of measuring with a wheel tape is not sufficiently accurate; that the best measuring tool is a micrometer caliper designed to contact the wheel flange in measuring.

One member called attention to the need for more accurate spacing of wheels on axles, since wide spacing on a tight track tends to produce broken flanges. Another member pointed to the necessity for a rapid, accurate wheel press gage so that mounting pressures will be definitely known.

E. G. Bishop, I. C., suggested that the association conduct an investigation so as to develop some definite information regarding the desirability of grinding car journals instead of rolling them, which is the present general practice.

In response to a question, J. A. Deppe, C. M. St. P. & P., said that when a single wheel shop does the work for an entire system, it should preferably be located at the center of use rather than at the center of system mileage.

(*The report was accepted and ordered printed.*)

## Freight Car Inspection and Preparation for Commodity Loading

The relatively small number of freight cars built new, rebuilt or completely reconditioned during the past year and the none too bright an outlook for the future makes the subject of freight car inspection and preparation for commodity loading even more important than heretofore, and if we expect to hold for our respective roads the business they now have and attract new business, we must continue to improve our practices and provide our customers with better service by furnishing them with cars that are clean and in proper physical condition to carry their products to destination without loss or damage.

In our report last year, we suggested that inspection and carding of cars for commodity loading should be done at main terminals or points where repair forces and facilities for cleaning and making necessary repairs were available. This recommendation is renewed and should be followed to the fullest extent consistent with operating conditions. This does not mean that agents and other employees at outlying points should not inspect cars for commodity loading that are available at their respective points. Thorough inspection and intelligent carding by qualified car inspectors at points where cleaning facilities and repair forces are available will, however, result in fewer cars being selected by agents that are not in proper condition for loading.

Our report as submitted a year ago outlined minimum requirements as to cleanliness and physical condition of cars for loading the following commodities: news print paper; flour, sugar and other food products that do not require refrigeration; furniture, doors, dressed lumber, etc.; bulk grain; merchandise and similar commodities; rough freight, and obviously this report referred primarily to box and automobile cars that are ordinarily used for loading these commodities. During the past year there have been no particular changes in requirements as to cleanliness and physical condition of box and automobile cars for loading such commodities.

Compliance with minimum requirements outlined in the report of this committee a year ago will further reduce loss and damage claims that result from loading box and automobile cars that are not in proper condition.

The following is submitted as being minimum requirements covering inspection and preparation of refrigerator cars that are to be used for loading perishable commodities:

Car must be in general good condition for service as to trucks, sills, couplers and draft gears, safety appliances and other running gear parts.

The top of the car must be examined to develop if the roof is in good order and that all hatch covers, plugs and hatch frames are in suitable condition or can be properly repaired before car is reported suitable for initial icing or loading. Ceiling must be inspected for openings or the appearance of a leaky roof. If mold on the ceiling indicates the roof has been leaky, a further inspection of the roof must be made to develop if recent roof repairs have been made correcting this defect. All evidence of mold must be removed.

Floor racks must be inspected and raised, floors examined, and existing defects repaired. The floor pans must next be inspected and any leaks found in the pan or around the trap must be sealed. Car must not be reported suitable for refrigeration loading unless pan leaks can be stopped. All traps must be equipped with caps, cups, or some device that will insure a water seal that will prevent the air from the outside entering car when iced. All cinders, dirt, or any other substance must be removed from floor pans and traps and all drains *must* be fully open—this must be determined by passing a test stick entirely through drain pipes.

### Detailed Attention to Refrigerator Cars

After cars have been inspected as indicated above and it is determined they can be conditioned for loading, the floor racks and the car floor must be thoroughly swept and washed, if necessary; pans, traps and drain pipes thoroughly cleaned; side doors must be inspected; defective door padding must be replaced and sufficient door padding added if necessary to make doors air and light tight when closed. Hatch plug padding must be examined and renewed if defective, or necessary padding added

to effect an air tight fit all around. An inspection must be made from the inside of the bunker to determine that hatch plugs fit properly and that no light shows around the edges of any of them and sufficient hatch plug padding must be added, if necessary, to make a light-tight fit. Side doors and door headers must be inspected from inside cars with the doors closed and latched and, if any light penetrates in the car around doors, sufficient padding must be added to exclude all light when doors are closed. Door header openings must be plugged with hairfelt or a suitable substitute. Loose siding, roofing, inside lining, ceiling and fascia must be renailed; protruding nails must be removed; missing sub-floor replaced; loose or missing floor rack boards renailed or replaced; loose bulkheads secured or braced; loose galvanized iron tank lining or tank screens replaced and secured; and all paper, strips, and other obstructions, removed from all bulkhead screens or openings. All floor racks must be properly secured. Door rods and sockets at top and bottom of door must be in good repair to assure doors fitting tightly. Roof ventilating attachments must be examined and made operative. It is necessary that roof ventilating attachments, including hatch covers, seal pins and chains, hatch cover levers, hatch cover lock lever guides and hatch cover lever anchors are intact and operative. If any of these parts are defective or missing they must be renewed or repaired before car is reported as suitable for loading.

No car must be reported as suitable for loading in which offensive odors are present, or if the floor, sidewalls, or bulkheads have been contaminated by or contain any salt, oil, grease, fats, or any other foreign substance. Cars containing a small amount of salt, oil, grease or fat can usually be made suitable by washing their interior; this should be thoroughly done and all salt and grease entirely removed, as a very small quantity of salt or grease will seriously damage certain commodities by contact. Floor racks should first be thoroughly scrubbed with a broom soaked in soapy water, the racks should then be raised and the floor scrubbed in the same manner. After the foreign matter has been washed out of the car the racks and floors should be rinsed with clear water.

The following formula is one of the best for washing cars when odors are not present: 1 gal. water (preferably hot); 2 lb. soda ash; ¾ lb. hydrated lime.

The above solution to be stirred thoroughly before using. If the above ingredients are not available, water suitably strengthened with soap powder, washing powder, concentrated lye or potash can be substituted.

After car has been washed the hatch plugs must be dropped into bunkers and hatch covers set in ventilating position, allowing a current of air to flow through the car through the hatchway. If possible, cars should be ventilated in this manner in motion when traveling from the conditioning track to the icing station or to a loading station. Side doors should remain open while washed cars remain on cleaning track permitting them to dry out thoroughly. One treatment as outlined above will usually correct the condition of a car previously loaded with salt meat, lard, oil, fruits or vegetables other than onions or cabbage.

### Removing Persistent Odors

Persistent offensive odors frequently are present in cars previously loaded with onions or cabbage if a portion of the contents are allowed to remain and decay in the car; also cars loaded with cheese, shrimp, oysters or fish are at times very hard to restore. Frequently several washings and fumigations are necessary to cleanse and purify such cars. The following solution has proven very good in such cases: 1 gal. water; 1½ lb. soda ash; ½ lb. bleaching powder (chlorinated lime).

The bleaching powder must be stirred up in just sufficient water to make a smooth paste without lumps. Then reduce the paste in the full amount of water before adding the soda ash. The full solution should be stirred before using.

When fumigation is necessary, before it is started, all hatch plugs must be placed tight in the hatch-ways and while fumigation is in progress side doors must be closed tight in order to retain all fumes possible within the car. Cars should be closed three or four hours after fumigating fires are started.

In mild cases the burning of two railroad fuses inside car will restore them.

Frequently burning two ½-lb. sulphur candles (one in each end of car) will correct the condition. At times it is necessary to burn two additional ½-lb. sulphur candles if the last fumigation does not suffice.

A more effective method than either of the above is to saturate one pound of waste or burlap in one quart of pure turpentine and add one pound powdered sulphur, placing this mixture in a bucket or some vessel that will prevent car from catching fire. Ignite the turpentine, waste and sulphur, allowing the fumes to remain in the car three or four hours before opening it up.

Another good method of fumigation is to burn two pounds lump sulphur one pound lump Sal-ammoniac in a tinner's fire pot or similar vessel with enough charcoal or kindling to completely consume the sulphur and Sal-ammoniac. This will correct cases that cannot be corrected with sulphur candles or turpentine.

Another effective method of fumigating cars is to burn two formaldehyde candles of the kind used in disinfecting sick rooms. These can be secured at most drug stores.

Great care must always be taken to prevent fire when fumigating cars; when burning charcoal or turpentine a large sheet of tin or other fireproof material must be placed on the car floor under the fire. Formaldehyde candles have receptacles that must be filled with water.

### Ventilation and Heater Service-Safety

When conditioning cars for ventilation service, they must receive the same inspection and repair attention as cars to be used for refrigeration service and, in addition thereto, all ice must be removed from ice bunkers.

Instructions covering the conditioning of cars for Ventilation Service will apply to the preparation of cars for Heater Service and Carriers Protective Service, with the addition of the following:

Kraft paper or equal, must be applied the full width of car on the loading space side of the bulkhead wall on cars equipped with Bohn, open, or slatted bulkheads, leaving openings for air circulation 15 inches wide from the floor upward and 15 inches wide from the ceiling downward.

Varying methods of papering, racking and placing heaters in cars are in effect in different shipping sections for various lading, during different seasons, and this work must be done to suit existing local conditions as requested by operating department representative in charge of the district or loading station.

Heated-car warning cards must be applied to door on each side of every car artificially heated and must be removed when heaters are taken out.

When cars are equipped with heaters using either charcoal or charkets, *all persons are warned* against remaining in such cars *with doors and hatches closed. Doors or hatches must be* left open for a few minutes before entering.

(*Continued on page 485*)

J. R. Jackson
President

**Speed—Economy—Use—Themes at**

# Locomotive Supervisors' Meeting

**Among the subjects discussed were braking of high-speed freight and passenger trains, locomotive utilization and locomotive economy devices—Many aspects of fuel economy considered in committee reports**

DEVELOPMENTS in the braking of high-speed trains, both freight and passenger, were considered at the third annual meeting of the Railway Fuel and Traveling Engineers' Association held at the Hotel Sherman, Chicago, October 17, 18 and 19, along with the problems of fuel conservation. George J. Leahy, Republic Coal & Coke Company, in an address, stressed the partnership of the railways and coal-mining industry and pointed out that revenue from coal traffic of the Class I railways, is fifteen times as great as the oil revenue and questioned the business sense of the extensive use of the Diesel locomotive. Others who addressed the convention were Lee Robinson, superintendent equipment, Illinois Central; and W. A. Hurley, assistant general superintendent, N.

G. M. Boh
Vice-President

W. H. Davies
Vice-President

Y. N. H. & H.; D. S. Ellis, chief mechanical officer, C. & O., and Roy V. Wright, editor *Railway Mechanical Engineer,* were also called upon for brief talks.

Mr. Robinson dealt with the relationship between the maintenance and operation of locomotives and stressed the need for an outlook beyond departmental walls by all supervisors under present conditions. Mr. Hurley, who presented the operating officers' view of fuel economy, stressed the importance of education of employees to adapt them to the changing conditions which they must face during the coming years. Mr. Ellis stressed the need of coordination of the work of all departments. "Don't be prejudiced or too proud to recognize the claims of the other fellow," he said. He also emphasized the need of all having to do with the maintenance or operation of locomotives to know their power and to take measures to have it properly assigned. Mr. Wright called attention to the slowness with which men come to understand each other and learn to cooperate and the apparent reluctance with which industry in general has recognized the importance of the human element as a factor alongside materials and machinery in production. This, he said, is at the bottom of a whole group of problems in the railroad business and expressed the hope that the association would give the human element a large place in its program.

John R. Jackson, engineer tests, Missouri Pacific, president of the association, in opening its first session, reminded the members of the joint session of the four associations, addressed by L. W. Baldwin, chief executive officer, Missouri Pacific, which had preceded the separate meetings of the four associations and recommended that such a joint session become an annual feature of the concurrent meetings of the coordinated associations and that, beginning with next year, the arrangements for this session be handled by a joint committee of the groups represented.

### The New Officers

Elected to serve for the coming year were the following officers: President, G. M. Boh, district road foreman of engines, Erie; vice-presidents, W. H. Davies, superintendent air brakes, Wabash; L. E. Dix, fuel supervisor, Texas & Pacific; and A. A. Raymond, superintendent fuel and locomotive performance, New York Central. The following were elected to serve on the Executive Committee for two years; J. A. Burke, supervisor air brakes, Atchison, Topeka & Santa Fe; E. E. Ramey, fuel engineer, Baltimore & Ohio; W. C. Shove, general road foreman of engines, New York, New Haven & Hartford, and W. R. Sugg, superintendent fuel conservation, Missouri Pacific. A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific, and R. S. Twogood, fuel engineer, Southern Pacific, were elected to the Executive Committee.

Summaries or abstracts of the addresses, papers and reports presented during the meetings follow. In addition to those here printed, a report by the Steam Turbine and Condensing Locomotive Committee was submitted by L. P. Michael, chief mechanical officer, Chicago & North Western. This report will appear in a later issue. J. B. Crawford, fuel engineer, C. B. & Q., presented a report on Fuel Wastes and Losses in the form of a list of items meriting attention.

## The Partnership of Coal Mines and Railroads

**By George G. Leahy**

Republic Coal & Coke Company

George G. Leahy, who spoke as a representative of the National Coal Association, emphasized the fact that the interests of the railroads in the coal industry are closely related and that the two industries are largely dependent one on the other. He cited the prosperity of the coal-carrying roads and the lack of prosperity of the roads which carry a relatively small volume of coal. He also made a comparison of the salesmanship of each of the industries to the other, from which he concluded that the railroads had been the better salesman. In 1938, for instance, the average price at the mine of railway coal was $1.92, while the average revenue received by the railway per ton of bituminous coal hauled was $2.27. Furthermore, he pointed out that the railroads sold three times as many of their units to the coal industry as the coal industry sold to the railroads. Examining the trends in the prices charged by the two industries, he found that the price of railroad coal per ton, including transportation and handling, was $3.94 in 1922, while 16 years later, in 1938, it had dropped to $2.50, a reduction of 37 per cent. The railroad revenue per ton of bituminous coal had dropped during the same period from $2.36 to $2.27, a reduction of but 3.6 per cent.

He then showed how the railroads and the bituminous

A. A. Raymond
Vice-President

T. Duff Smith
Secretary-Treasurer

coal industry had shared in effecting a marked reduction in railway fuel costs—the railroads, by improvements in locomotives and better supervision of fuel consumption; the mines, by improvements in the quality of the fuel on the car and by reductions in price. In 1921, 162 lb. of coal were consumed per 1,000 gross ton-miles and the average cost of fuel was $4.10. In 1938, fuel consumption had dropped to 115 lb. per 1,000 gross ton-miles and the price per ton to $2.50. These two factors resulted in a drop in cost per 1,000 gross ton-miles from 33.2 cents in 1921 to 14.37 cents in 1938. The reduction in fuel consumption was such that the coal actually consumed in 1938 was 21½ million tons less than would have been consumed to move the same trains in 1921. The saving in money at the 1921 price was 88 million dollars and, at the 1938 price, 55 million dollars.

### A Coal Man's View of the Diesel

Continuing, Mr. Leahy spoke in part as follows:

"Let me refer to the use of a new medium of motive power by the railroad partner which is disturbing his coal partner; that is, the Diesel engine.

"Perhaps the Diesel has some advantages over the steam locomotive, and undoubtedly the steamer has some advantages over the Diesel and so they may be considered competitive in their fields. But the railroads must have revenue freight before they can purchase or utilize either the steamer or the Diesel, and there is no competition as between the amount of freight revenue provided by the coal industry which furnishes fuel to the steamer, and that provided by the oil industry which furnishes fuel to the Diesel.

"The railroads received about 40 millions of dollars annually from the transportation of fuel oil, and about 600 million dollars annually from the transportation of bituminous coal. There may possibly be a few individual roads who receive more revenue from the transportation of oil than they do from coal, and if so, they should be commended for exploiting and extolling its merits. But for the Class I railroads as a whole, the coal revenue is fifteen times as great as the oil revenue, and it would appear not only commendable but just plain good business sense for them to exploit and extol the use of coal.

"Coal is returning very rapidly to favor for house-heating in connection with the small stoker. Every increase in the use of coal means additional revenue for the railroads, whereas whenever the use of oil grows to large proportions in any area, the oil companies construct a pipe line and keep their transportation charges within their family. Sometimes a railroad provides a portion of its right of way for the pipe line route—but, of course, we must not overlook the fact that by so doing they usually receive the haul on the pipe that deprives them permanently of their oil revenue. Any assistance which the railroads may give to extending the use of coal will be in the secure thought that the traffic will not be diverted to a pipe line after it has been developed.

"We have seen that the railroads have put it all over the coal man in the reciprocal purchase and sale of their respective commodities, and now we find that the railroads are pikers and second-rate salesmen themselves when compared to the oil men. The year 1938 is typical of preceding years. In that year the railroads received from the oil men revenue for transportation of 37 million dollars, but they paid out to the oil men for fuel oil and gasoline 57 million dollars. Contrast that with coal for the same year when the railroads received from the coal men for transportation 511 millions of dollars, and paid out to the coal men for coal 174 millions."

## Locomotive Maintenance and Operation

**By Lee Robinson**

Superintendent Equipment, Illinois Central

Lee Robinson, superintendent equipment, Illinois Central, in an address on Maintenance and Operation of Parts and Appliances which have to do with good combustion, emphasized the need for close co-operation between those having to do with operation and those charged with the responsibility for maintenance; indeed, between all departments. The time has passed, he said, when railroad men can afford to confine their interests to narrow departmental compartments; they must work together for the best interest of the railroad as a whole.

He pointed out the splendid record which has been made since 1920—an increase in freight-train speed of 53 per cent; in gross train load, of 29 per cent; in gross ton-miles per train-hour, of 96 per cent; in gross ton-miles per active locomotive, of 50 per cent, with a decrease in coal consumption per locomotive-mile of 14 per cent. This record, he said, is not enough because, with other forms of transportation taking business from the railroads, government bodies and other organized interests pressing for lower rates on the one hand and increasing costs of labor and materials on the other, the only opportunity to maintain a reasonable margin of profit is to reduce the cost of operation. He also warned that the demand for more speed, both in freight and passenger service, has increased train-operating costs and created avenues for wasteful practice which will get out of bounds if not closely watched.

Such are the problems of today. In speaking of the outlook for the near future, Mr. Robinson continued in part as follows: "Has the conventional steam locomotive reached its ultimate development to meet economically the demands placed upon it? Can a reciprocating type of engine be built for higher speeds than we are now averaging without creating undue and damaging stresses both in the engine itself and the track structure? If steam is continued as the prime mover, will the unit take on some other form of design and appearance than the locomotive so familiar to all of us?

### New Forms of Motive Power

"We now have the Diesel locomotive, which you will have to agree has developed very rapidly in the past five years. Naturally, at the outset the first cost was almost prohibitive, except for experimental purposes, but with the increasing development and use of such units, which permits building them on a production basis, the cost has gradually decreased. This cost will, no doubt, continue to be reduced, as increasing numbers are built and placed in service.

"When you consider the greatly increased distances this type of motive power can run without terminal servicing, thereby reducing the total number of units required for a complete trip, when you can eliminate a great number of auxiliary facilities such as coaling stations, water stations, cinder pits, roundhouses and turntables, then the first cost does not appear such a large

factor, and give this type of power a distinct advantage over the present steam locomotive.

"Also we have the experimental or development unit consisting of a high-pressure flash boiler with high-speed steam turbines operating condensing, geared to generators furnishing current to the traction motors for propulsion, which I think is the first challenge that steam construction in a different form than the conventional locomotive has made to the Diesel locomotive.

"Other developments in the form of more efficient transmission of power from the prime mover to the rail are becoming more and more in evidence. Now, do not get the impression that I think the steam locomotive, our old friend, is going to pass out of the picture at once, because we will have it with us for a long time, but it is going to have some lively competition."

## Locomotive Design Factors to be Avoided

**By F. P. Roesch**

Vice-President, Standard Stoker Company

In his paper F. P. Roesch, vice-president, Standard Stoker Company, dwelt on certain features of the combustion equipment of the steam locomotive which are susceptible of improvement. He stressed the importance of adequate air openings into the ash pan to prevent the formation of a vacuum in the pan. He cited a case in which the correction of such a condition recently permitted an increase of ½ in. in the nozzle diameter of several locomotives, effecting a substantial saving in fuel and greatly increasing the efficiency of the locomotives.

In discussing the front end he referred to University of Illinois Bulletins Nos. 256—A Study of the Locomotive Front End, Including Tests of a Front-End Model, and 274—A Supplementary Study of the Locomotive Front End by Means of Tests on a Front-End Model—issued, respectively, on May 30, 1933, and May 21, 1935, as a source of explanation of the function of the front end in producing draft.

With respect to the Master Mechanics' front end with which a large number of locomotives are equipped, he suggested that the recommendations of the Committee on the Revision of the Master Mechanics' front-end arrangement, submitted to the Mechanical Division of the A. A. R. in 1936, be followed. In this connection he pointed out the necessity for internal streamlining to avoid obstructions to the flow of gases through the front end. The removal from the front end of the exhaust-steam-supply pipes for feedwater heaters and injectors should present no difficulties in new locomotives.

### Discussion

One feature of locomotive design which affects fuel economy not mentioned by Mr. Roesch was brought out from the floor. That is the action of heavy air currents from over the cab into the coal space in the tender in high-speed service. The effect is to whip fine coal and, in some cases, coal as large as the nut size out of the tender and to scatter it back over the top of the train.

## Fuel Conservation from the Viewpoint of the Superintendent

**By W. A. Hurley**

Assistant General Superintendent, New York, New Haven & Hartford

The opportunity to save fuel is ever present in the operating department, said W. A. Hurley, assistant general superintendent, the New York, New Haven & Hartford, in his address. He outlined the relations of the various officers on the division to the problem of fuel economy. The skill with which the chief train dispatcher makes up the timetables has a marked effect on the coal pile, and the smoothness with which the dispatchers and yard masters work together in getting cars out of the yard and trains into the yard without delays directly affects fuel economy. He pointed out the importance of care in establishing engine ratings. Either under-rated or overloaded locomotives waste fuel. The happy medium must take account of the need to maintain the service which the patrons expect.

"The train dispatcher," said Mr. Hurley, "being the supervising official with whom all the men on the road come in direct contact practically each day, undoubtedly has the opportunity in the course of his daily work to do more than many other employees to get 100 per cent efficiency, with its resultant savings in fuel and satisfied customers. When this feeling of teamwork is instilled and established on a division, unnecessary stops and delays are eliminated and the pounds of fuel per thousand gross ton miles immediately decrease."

After referring to the opportunities in the handling of locomotives through the engine terminal to prevent waste of fuel, Mr. Hurley came to the engine crews. "It is not always the fault of the enginemen and firemen," he said, "that they are not fully posted on all the refinements of the modern locomotive. Many of these improvements have come along in the last few years, and are somewhat complicated in their construction and handling. All of us are growing older, and some of us do not have the faculty that we did 20 years ago to absorb quickly the knowledge that is necessary and helpful in our everyday work, unless some supervisor sits with us and explains just what it is all about. It has been my experience that a 30-minute talk with a person who is fully qualified on his subject is worth more than two hours' time in trying to fathom out a book of instructions.

"An engineman arriving at the enginehouse after completion of his day's run usually has his mind filled with items which he intends to enter in the work book. Some are necessary, while others may be partly imagination. Whether or not these items are properly reported in a manner that enables the foreman or inspector to know just where to look for the trouble and whether or not to order the pit foreman to dump the engine, depends to a large extent on just what kind of a road foreman or fuel supervisor is in charge of the territory over which this engineer operates. If he has never been properly in-

structed on how to report work in the right way, we may expect such items as these on the work book: 'Engine blows.' 'Engine pounding her head off.' 'Engine don't steam.' 'Can't keep water in boiler.' 'Engine won't run.' 'Steam leaks around front end; can't see signals.' On the other hand, if the crew has been properly instructed by the road foreman or fuel supervisor, we may expect reports like the following: 'Engine blowing in right cylinder; renew cylinder packing.' 'Left main rod pounding; reduce back-end brass.' 'Right main crown brass worn.' 'Engine not steaming properly due to load of fine coal; not necessary to dump.' 'Engine not steaming; flues plugged.' 'Two bricks missing from arch, left side; clean out openings in grates.' 'Injectors not working properly; clean out tank and strainers in tank hose.' (This last item would be given to the ash pit foreman by the engineman with instructions not to fill the tank with water until this work had been completed.) 'Pins in valve motion, right and left sides, worn.' 'Clean out exhaust nozzle.' 'Repack left piston.' 'Staybolt leaking under lagging about center of boiler, right side.'

"If these two engineers happened to be on opposite sides of the same run, a glance at the train sheet and at the coal pile on arrival at their terminal would undoubtedly tell another interesting story.

"Education, today more than ever before, has become a necessity. Practically all large and small business concerns are forming educational courses for their employees better to fit them for their positions in these days of keen competition. Why should the railroad man be different from the employee of any large selling organization? The railroads sell transportation, and transportation only. Just how well we succeed in the next few years depends on how well we educate our employees."

Mr. Hurley said that the answer to these conditions for the traveling engineer and fuel supervisor is to ride every locomotive as often as possible. "The enginehouse road foreman or fuel supervisor, like the office trainmaster and the switch-cabin yardmaster, is obsolete," he said. "Get away from the office and the enginehouse detail! Leave a note for the general foreman or call him on the telephone."

# New Locomotive Economy Devices

## The front-end stoker—A new installation of poppet valves—Movie study of foaming

### Feedwater Heaters

No new developments in feedwater heaters have been called to our attention. One manufacturer of feedwater heating equipment, however, is working on the development of a condenser for the purpose of increasing the amount of water reclaimed from the main exhaust channel. It is proposed to provide sufficient condensing surface, to be blown by a fan driven by an exhaust-steam turbine, to condense about 10 per cent of the main engine exhaust. The steam so condensed would be returned to the tank as feedwater and would be in addition to the 12 to 14 per cent returned by the usual feedwater heater making a total of from 22 to 24 per cent of water reclaimed. To date no applications have been made but, however, the details have been worked out and the manufacturer will keep us advised as to future applications.

The extended use of feedwater heaters, particularly in connection with high-pressure boilers, has emphasized the necessity for providing means to insure that cold water be prevented from entering the boiler when the main throttle is shut off. We have previously described a device which uses live steam introduced immediately at the head of the boiler check for this purpose. The Worthington Pump & Machinery Company has added to its system of open feedwater heating, a spray nozzle to be used in connection with a top boiler check which divides the feedwater entering the boiler into finely divided streams. This permits the water to pick up temperature in passing through the steam space and in this way reducing the shock to the boiler.

### Locomotive Valves

In the report to the association of 1937, mention was made of a poppet type valve for steam locomotives. The development has proceeded to the point where test application has been made to a Pennsylvania K4s Pacific type locomotive, which left the shop on August 28. No results have yet been made available but it is hoped that by next year's report some detailed information will be obtained for report to the association.

In this connection attention is directed to the report of the Committee on Further Development of the Steam Locomotive of the Association of American Railroads, Circular DV958. This circular calls attention to the necessity for improving the steam distribution in locomotives of high horsepower for high-speed operation. This committee recognizes that possibly the poppet valve is the only arrangement which satisfactorily fits the purpose.

### Locomotive Stokers

On one railroad, with the so-called front feed stoker, we find that means have been provided for introducing the coal feed in the front end of the firebox under the arch rather than in the conventional location immediately ahead of the fire door. This means of feeding coal has certain obvious advantages, particularly for such railroads as find it necessary to burn coal with considerable percentages of fines.

In previous reports this committee has frequently called attention to the effect of rather unrelated items on the matter of locomotive fuel economy. At times it has delved into the matter of feedwater heating at terminals and to some extent on feedwater treatment. With the extended use of high-pressure, high-superheat locomotives operating over long runs the matter of the condition of the water in the boiler is becoming of greater and greater importance. This is particularly true in respect to water conditions which bring about foaming in the boiler. Obviously excessive foaming with its attendant reduction and at times total elimination of superheat and all of the evils of the carrying of solid matter into the superheater and thence into the valve chests, cylinders and auxiliaries being operated by superheat steam naturally has a very bad effect on the fuel economy of the locomotive.

The subject of foaming has always been more or less mysterious since it occurs inside of the boiler, being more or less invisible. The Missouri Pacific, in conjunction with the Electro-Chemical Corporation, have lifted the veil and made the interior of a boiler under steam

visible. By the application of glass peep plugs and suitable interior illumination of the boiler it was found possible to take moving pictures of a locomotive actually producing steam at various rates.

The test was conducted in the manner usually followed in standing boiler tests of locomotives. This involves merely the removing of main valves and blocking the piston and wheels in such manner that the engine remains stationary. The desired back pressure and hence draft is produced by opening the throttle until such back pressure is obtained and at the same time suitable disposal is made of the steam produced by the boiler. While this makes an unholy racket, it is still a very convenient means for this purpose. The pictures also show a suggested solution for the control of foaming and the prevention of excessive carry over into the dry pipe and thence into the superheater.

### A Look Inside the Boiler

Following the completion of the presentation of the report by Mr. Hoppe, the moving picture showing the action of the water surface inside the boiler taken through windows in the dome was presented. This picture shows rapid forward movement of the water surface and, under foaming conditions, the tendency of the water level to rise, the water below the surface assuming a more or less tenacious spongy consistency. The interpretation of the observations which have been made in this study is that water is carried over into the dry pipe by the whipping action of the steam, which results from the reduction in the area through which the steam must pass over the top of the liquid when the surface rises in the manner indicated. The reduction in steam-passage area over the top of the water increases the velocity and, therefore, the amount of water picked up. The importance of reducing obstructions to permit free flow of steam above the water surface was pointed out.

The moving pictures also showed the action of a trough installed by the Electro-Chemical Engineering Corporation into which the surface water spills when the level rises under foaming conditions which tend to skim off surface impurities to be blown off from the boiler.

In the discussion of another report, a representative of the Baltimore & Ohio referred to the front-end stoker already mentioned in this report, the development work on which has been done on that road. He said that stokers for 50 locomotives have already been bought for the B. & O. and several for the Alton. This stoker, he said, had been developed primarily to reduce stack losses and that it shows a cinder loss 30 per cent less than other stokers and burns 14 per cent less coal per 1,000 gross ton-miles.

The report was signed by A. G. Hoppe, assistant mechanical engineer, C. M. St. P. & P.

### Discussion

Following the showing of the moving pictures, in answer to several questions it was stated that foaming is a function of suspended matter as well as of dissolved matter. Impurities as low as 150 grains per gallon will cause foaming if conditions are right. In other cases, 1,500 grains per gallon will not cause foaming. The need for more consideration of the location of the dome was also stressed. It was suggested that solid water might be picked up even in the absence of foaming if the dome were placed on the first course and the entire volume of steam had to pass over the water for the entire length of the boiler.

## Utilization of Locomotives

### Proper location of coaling stations or large tenders facilitate long locomotive runs

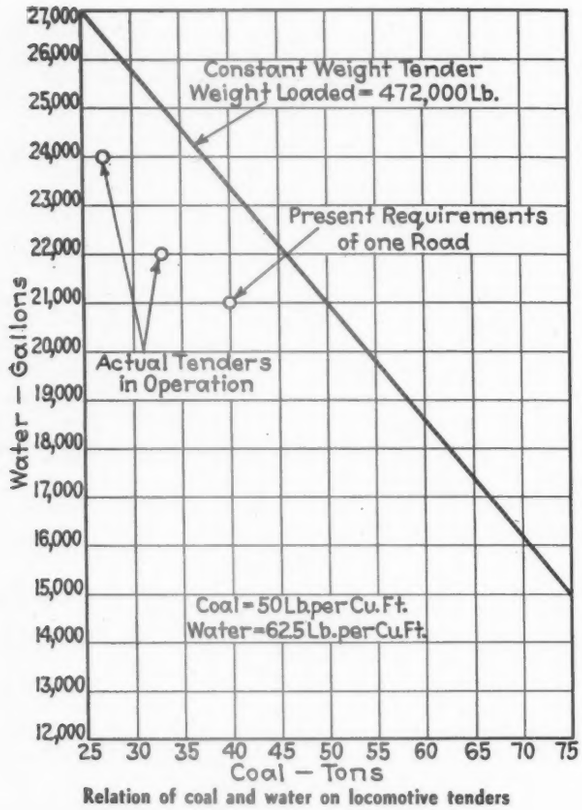
The report discussed the limitations which restricted tender fuel capacity place on long locomotive runs and suggested the methods by which these limitations can be removed. He cited a situation in which a passenger locomotive uses up the greater part of its fuel supply in 350 miles. If the coaling plant is so located that a special stop must be made, a five-minute delay would mean a waste of 1,500 lb. of fuel for the delay and to replace, say, the 727 million foot-pounds of energy lost in stopping the train from 80 miles an hour. Should the schedule be such that the extra stop cannot be permitted, to change the engine will cost 150 lb. getting to the enginehouse, 600 lb. for cleaning and banking the fire, 1,200 lb. for six hours in the house, and 750 lb. to break up the bank and place the locomotive on a train, a total of 2,700 lb. In the latter case two locomotives are required for the run.

In discussing the fueling of switching locomotives the report referred to the many outlying points from some of which the locomotives have to go as far as four or five miles for fuel. Where there are eight or ten locomotives working in the same neighborhood under such conditions, the possibility of installing a small mechanical coaling plant at a cost of about $3,500 was cited. In one such location where 15 locomotives were formerly handling the work 12 locomotives were able to take care of the work after the installation of such a plant. In addition to the reduction in the number of locomotives, 10 tons less fuel was used per day, or 300 tons per month, a saving of $900 per month.

Another solution of the problem of long locomotive runs which the report discussed is the large tender. On the chart are plotted tenders based on two groups that are in actual operation. Taking the total weights of these tenders, a line is drawn through them showing the relative proportion of water or coal that they can carry. The chart shows that with 75 tons of coal the maximum water which can be carried is 15,000 gallons. Similarly, with 25,000 gallons of water the maximum coal capacity will be reduced to about 33 tons.

With the 75-ton tender applied to the situation as cited in the report replacing tenders of 15,000 gallons and 30 tons capacity, which would require two coal stops en route on a 1,000-mile run, the net cost in fuel to haul the larger tender is calculated to be 2,240 lb. This estimate is arrived at by assuming a consumption of 100 lb. of coal for each additional 1,000 gross ton-miles resulting from increased average tender weight, less 3,000 lb. of coal required for two coal stops with the smaller tender.

The report also presented a comparison of the locomotive-miles per active locomotive day for the 13 railroads operating the largest number of locomotive-miles, shown separately for passenger, freight and switching service for the first six months of 1939. The highest mileage in passenger service is 269.7; the lowest, 144.7.




**Relation of coal and water on locomotive tenders**

The average for the United States is 183.5. The highest mileage is equivalent to an average daily working time of only 6.39 hours. In freight service the highest daily mileage was 123.7 and the lowest, 81.9. The average for the United States is 102.1. The best performance is equivalent to a daily working time of 7.19 hours. In switching service the highest performance is 78 miles, and the lowest 46.2 miles. The average for the United States is 66.6. The 78 miles a day is equivalent to an average daily working time of 13 hours.

The report concludes with a summary of specific suggestions as to how locomotive utilization has been increased by long locomotive runs or more frequent turns. Suggestions affecting other details of practice which have a bearing on locomotive utilization are also discussed.

The committee acknowledged the receipt of valuable information and assistance in the preparation of the material for the report from F. W. Hankins, assistant vice-president-chief motive power, Pennsylvania; G. McCormick, general superintendent motive power, Southern Pacific; J. W. Burnett, general superintendent motive power and machinery, Union Pacific; K. F. Nystrom, mechanical assistant to chief operating officer, C. M. St. P. & P.; G. H. Emerson, chief motive power and equipment, B. & O.; H. H. Urbach, mechanical assistant to executive vice-president, C. B. & Q.; A. R. Ruiter, assistant to chief operating officer, C, R. I. & P., and J. Purcell, assistant to vice-president, A. T. & S. F.

The report was signed by A. A. Raymond (chairman), superintendent fuel and locomotive performance, New York Central; C. M. Darden, superintendent machinery, N. C. & St. I.; G. Hill, superintendent motive power and cars, W. & L. E.; T. Olson, superintendent motive power, C. B. & Q.; N. T. Dempsey, C. R. I. & P., and E. G. Sanders, fuel conservation engineer, A. T. & S. F.

## Locomotive Firing Practices—Coal

### The committee gives particular attention to a discussion of the causes of honeycombing

In order to fire a locomotive properly a fireman need not necessarily know everything about the theory of combustion; in fact many good firemen do not know a great deal about the theory but a fireman who is familiar with these principles is better qualified to cope with varying conditions in the locomotive firebox.

The problem of fuel conservation involves both mechanical and human factors. The proper functioning of both is essential for efficient results. The mechanical engineering skill of the world is hard at work and there have been wonderful strides made in steam locomotive development during recent years. The human factor involved in railroad operation is at a higher level of efficiency today than ever before. Nevertheless, the human factor, just as the mechanical factor, must continue to advance; therefore, education is still the key to proper and successful locomotive firing practice. Further, the supervisory forces should not only preach proper firing practice but should practice what they preach, and encourage firemen by actual demonstration of proper firing methods whenever possible.

The real secret of success in hand-firing lies in the ability to scatter coal well. After that secret has been mastered no difficulties are experienced in maintaining a light, bright, level fire at all times. The stoker does this when intelligently used.

Honeycombing or slagging of tube sheets is one of the leading causes of low steam pressure and fuel waste on many railroads. This subject apparently was of vital concern as far back as 1914. At the convention of the International Railway Fuel Association in that year, S. W. Parr, Professor of Applied Chemistry, University of Illinois, presented a paper dealing with honeycombing and clinker formation, the opening paragraph of his paper reading as follows:

"As a general proposition, the first step in any attempt to solve a difficulty should doubtless be taken along the line of a search for the underlying cause. If we approach the matter of honeycomb formation on flue sheets from this standpoint we are confronted at once with the fact that the cause must of necessity be more or less obscure owing to the difficulty of obtaining experimental evidence in the vital or formative phase of the matter."

The concluding remarks of his paper were as follows:

"First—the chemical condition, which seems to be most conducive to formation of honeycomb, is the one in which the percentage of iron pyrites is high.

"Second—any conditions in the combustion chamber which, by reason of the time interval for complete oxidation, or temperature stages, or deficiency in oxygen, which would promote the formation for any brief length of time of the iron pyrites in the ferrous sulphide stage, is a condition likely to promote clinkering.

"Third—the physical condition most active in promoting the formation of clinkering of particles in the fire box above the grates is found in the finely divided ma-

terial, which is both high in ash and high in iron pyrites.

"Fourth—at least one practical suggestion is indicated, namely, that so far as is possible the fine stuff be eliminated from the material as fired. Material of this sort may be much more readily handled in fires which are not conducted under such forced conditions as to draft and speed of combustion, it being only necessary to give ample access of oxygen until the time of complete burning out of the sulphur, after which the tendency to fuse is reduced to the minimum."

This subject was also included in Booklet II on Fuel and Related Economies, published by the American Railway Association in April, 1934.

A tabulation of the number of typical ash and sulphur values for different sizes taken from Illinois commercial coal which had been subject to the usual process of handling showed a consistent increase in ash and sulphur with the increase in the fineness of coal.

The importance of this subject is very evident from the fact that the Hudson County Smoke Abatement Association designated a committee to accumulate data for the enlightenment of its members. Their majority report, with the minority report, as written by W. G. Christy, Smoke Abatement Engineer, Department of Smoke Regulations, Hudson County, New Jersey, was published in April, 1938, issue of the *Railway Mechanical Engineer*. This subject was also a topic at the Master Boiler Makers' Association meeting in 1938.

Your committee feels that this subject should now be open for general "practical" discussion, in view of the many locomotives in service that are being worked beyond their predetermined rate; also many railroads are forced to burn inferior grades of coal. It is felt by many that the principal cause is a combination of high draft from whatever cause and certain grades of coal running heavy in fines and high in iron pyrites.

The report was signed by W. C. Shove (chairman), general road foreman of engines, N. Y. N. H. & H.; M. Cavanaugh, fuel supervisor, C. St. P. M. & O.; H. B. Grimshaw, fuel supervisor, Seaboard Air Lines; F. J. Hannon, traveling engineer, E. J. & E.; J. F. Jennings, superintendent equipment, Michigan Central; F. X. Jones, supervisor fuel and locomotive operation, Erie; J. J. Kane, road foreman of engines, Lehigh Valley; J. C. Lewis, road foreman engines, R. F. & P.; H. L. Malette, road foreman of equipment, St. L.-S. F.; G. S. Mikles, fuel supervisor, N. Y. O. & W.; H. Murphy, instructor fuel economy, B. & O.; T. V. Ramsey, road foreman of engines, Wabash; S. M. Roth, road foreman of engines, Western Maryland; H. W. Sefton, supervisor locomotive and fuel performance, C. C. C. & St. L.; W. E. Small, B. & M., and R. A. Stickney, fuel supervisor, Great Northern.

### Discussion

It is evident from the discussion that there is little correlation between many of the conditions associated with the formation of honeycomb and the extent to which honeycomb is actually experienced. In one case of stoker-fired passenger and freight locomotives using the same fuel more trouble was experienced with honeycomb in the freight locomotives than in the passenger locomotives. This was attributed to the fact that the freight locomotive had a combustion chamber only 18 in. long, while the passenger-locomotive combustion chamber extended into the boiler 48 in. The longer path of the gases in the latter case was assumed to provide time for the particles of slag to cool before striking the tube sheet.

The analysis of a sample of flue-sheet clinker from a coal with 13 per cent ash, of which 4 per cent was iron pyrites, was given. It was: silica, 26.5 per cent; iron oxide, 45.2 per cent; aluminum oxide, 13.12 per cent; calcium oxide, 6.79 per cent; combustible, 8.57 per cent.

It was pointed out that honeycomb is produced from many different coals, and that today it forms under one set of conditions and tomorrow under another. In one case cited honeycomb tends to form when the locomotive is working hard and little clinker forms on the grates. When the locomotive is working light, however, the conditions are reversed, clinker forming on the grates and little honeycomb forming on the tube sheet. It was pointed out that with Rosebud coal, which is burned on the Northern Pacific and which has but 0.5 per cent of iron pyrites, honeycomb forms at times. On the locomotives with 182 sq. ft. of grate and 78-in. combustion chamber, however, burning 15 tons of this coal per hour at the peak on ⅜-in. round-hole grates, no difficulty from honeycomb is experienced.

## Passenger-Train Braking

### Descriptions of graduated-release and short-cycling methods of mountain braking

The elements of the air brake system which lie between the brake cylinder and the rail directly limit the retardation obtained by an application of the brakes. These elements are the rail, the wheel, the brake shoes, and the foundation brake rigging. Recent changes in railroad operating practices have emphasized the important part these elements play in securing rates of retardation.

### High Retardation Rates

With trains moving at high speed, unexpected conditions may arise which will necessitate a reduction of speed, or a complete stop with very little, if any warning. It is then that the highest rate of retardation possible is imperative and it is the deciding factor in the safe operation of such vehicles. The stop distance can be roughly determined if the retardation is known, and it is expressed in so many miles per hour per second, indicating the reduction in speed of the train per second. The per cent retardation obtained by action of the brakes fixes the rate of retardation. Actual tests have demonstrated that a rate of retardation in excess of three miles an hour per second is difficult to obtain even with the modern light-weight trains, unless the rail is heavily sanded and the braking power evenly distributed on all wheels in proportion to the wheel load carried.

Even distribution of braking power means that each pair of wheels must be braked to the limit, keeping in mind that if the effective retardation equals the coefficient of adhesion the wheels will slide and lengthen the stop. Car wheels can be braked to the limit, but locomotive wheels cannot with any known equipment, not even on power trucks with Diesel or electric locomotives. This imposes an additional burden on the car-wheel brakes, which must assist to retard the weight of the locomotive in addition to that of the car.

If a stop is to be made from high speed within a

reasonable distance, it is important first to get the brakes applied as quickly as possible; a train moving at 90 miles per hour is covering 132 ft. per second. It is obviously important to set up the highest possible rate of retardation while the train speed is high. All train stop records show that when the speed has been reduced by half, about 80 per cent of the stop distance will be covered.

The ideal brake would, therefore, be one which would develop braking power just under the factor of adhesion through a stop that could be applied within two seconds or less on all cars simultaneously. To date there are two factors which place restrictions on too rapid application; one is passenger comfort, and the other is a tendency to set up extremely high friction values if too much shoe pressure is developed while the shoes are cold. It has been proved impractical to develop over 200 per cent braking ratio in less than three seconds with standard cast-iron brake shoes.

### The Disc Type Brake

Recently a new type brake has been developed which uses automotive type brake lining on a two-face disc bolted to the inside hub of each wheel. Because of the more uniform friction values of this lining it has been found possible to apply this brake with full power in nearly half the time it can be applied with cast-iron shoes without danger of sliding the wheels. This type of brake lining has a more uniform coefficient of friction throughout a stop than a cast-iron shoe, which eliminates the necessity of reducing the brake-cylinder pressure as the speed reduces to avoid sliding the wheels. It is also capable of setting up a higher rate of retardation during the early part of the stop, a very valuable feature.

If the wheels are to be braked up to the limit of adhesion when the rail is in good condition it follows that this limit will be exceeded when the wheels find a low rail joint, bad crossing, or a wet spot, in which case the wheels will slide. Therefore, if braking forces are to be employed materially in excess of present conventional brake practices, a device to prevent the wheels from sliding without interfering with safe operation of the train is necessary. The values of coefficient of adhesion have been reported by various experimenters ranging all the way from 8 per cent to 10 per cent without sand on a poor rail, to as high as 40 per cent on a good rail, the average being around 25 per cent.

To reduce the stop distance the method of sanding requires considerable study. Our very best present means of sanding the rails is entirely inadequate for speeds much over 30 miles per hour. Very little sand actually gets under the wheels at the higher speeds owing to sand pipes being too far away from the wheel-rail contact; and owing to the blast of air used to blow out the sand and the wind due to the movement of the train. To sand a rail properly at high speed the sand must be delivered close to the point where the wheel meets the rail and should be delivered in a thin sheet about 1 in. wide. Several manufacturers and railroad men are said to be working on improved methods of sanding or conditioning the rails for stopping high-speed trains.

To further improve the rail condition, there is much to be done in locating steam and water traps as far away from the rail as possible, as well as controlling the dumping of water and other refuse from cars, which at present in some instances is falling on the rail and creating a very bad condition when brakes are being applied.

Assuming that everything possible has been done to insure a good rail condition, the fact still remains that as the speed increases, the adhesion between wheels and rails decreases because of the bouncing of the wheel over the imperfect surface of the rail and because of the momentary unloading of the truck on account of the vertical oscillations of the car.

### Graduated Release on Mountain Grades

In handling conventional type of passenger car equipment on mountain grade districts, two general methods of braking are employed. One, known as the graduated release method, in which retaining valves are not used, has proved highly desirable in districts where undulation of the grade and curvature will permit complete release of brakes and recharging of the brake system at sufficiently frequent intervals to prevent depletion of the brake system pressures to a dangerously low point. The cooling of brake shoes and wheels during release periods is of material advantage and the inconvenience of operating retaining valves on head-end equipment is eliminated. This is especially advantageous on trains handling a high percentage of mail, express and baggage cars.

When handling passenger trains on descending grades by the use of the graduated-release method, the brake system must be charged to standard pressure before departure from the summit of the grade. After entering upon the grade and a speed approximately that permissible for the grade has been attained, a service brake application should be made sufficient to control the train at the desired speed. Allow the brake valve to remain on lap position until a change in speed is observed and if the speed continues to increase, make a further brake pipe reduction; if decrease in speed is noted make a partial release of the brakes by moving the brake-valve handle to running position until an increase of three or four pounds brake-pipe pressure is obtained, then return the valve to lap position. Succeeding partial releases may be made by increasing brake-pipe pressure approximately two pounds, using running position. If a reduction in speed is necessary, light additional service applications will accomplish the desired result. Often the desired increase or decrease in speed may be made by simply applying or releasing the locomotive brakes by use of the independent brake valve.

A complete release of the brakes and recharge of the brake system must be made at frequent intervals, taking advantage of curves and changes in grade to avoid excessive increase in speed during the recharging period. Every effort must be made to maintain a uniform speed and if applications and releases are properly timed no difficulty will be experienced in maintaining brake-system pressures and proper speed. Enginemen should try to anticipate necessary changes in speed and not wait until a condition of speed change makes necessary a drastic change in brake-cylinder pressure. If this is done the speed change will soon correspond to the change in cylinder pressure and an erratic speed would be the result. This is detrimental to brake shoes and wheels and should be avoided. An even speed will produce the most uniform wheel heat and secure the most desirable results, as by so doing air pressure will be conserved and smooth train handling will result therefrom.

To avoid damage to driving-wheel tires, the continuous use of the driver brakes should be avoided, except in cases where it becomes necessary to make a considerable reduction in speed or in bringing the train to a stop. The locomotives on many mountain railroads are equipped with a driver-brake release or a three-way cock located in the cab or a retaining valve on the tender which permits release of driver brakes while the tender and truck brakes remain applied.

In approaching stations at which spot stops are necessary such as in approaching water cranes, etc., the brakes should be applied on the train in the usual way by adjusting the slack in the train with light applications and

increasing the applications as necessary to accomplish the slow-down. The brake application should finally be sufficient so that if left applied it would stop the train short of the desired stopping point. Then, when the speed has reduced to approximately 15 or 20 miles per hour, a graduation of the brake-cylinder pressure should be started by moving the brake valve to running position and then back to lap. This procedure should be continued, reducing the brake-cylinder pressure as the speed of the train reduces, planning the stop so that little if any pressure is left in the brake cylinders when the stop is completed.

If error has been made in judgment so that it becomes necessary to reapply the brakes under these conditions before the brake-cylinder pressure has exhausted, the succeeding application should be made very light. If the brakes are entirely released, a five-pound brake-pipe reduction should result in approximately 10 or 12 lb. brake-cylinder pressure. If the brake-cylinder pistons are still out, even though no pressure is shown on a brake-cylinder gage, and a five-pound brake-pipe reduction is made, the brake cylinder pressure will be at least 25 lb. This emphasizes the necessity of care being exercised, when spot stops are being made, in making such applications sufficiently light to guard against harsh slack action.

### Short Cycling with the New Retainers

When retainers are used in mountain-grade braking the most successful method is found to be what is known as the short-cycle operation of the brakes. In the short-cycle method of braking, the brakes are applied with sufficient force to control the speed of the train and as soon as practicable are released, allowing the retaining valve to blow down the cylinder pressure gradually between cycles. This method provides for control and at the same time keeps the brake system practically fully charged.

The new A. A. R. standard passenger-car retaining valve, which provides for slow continuous blow down and complete release of brake-cylinder pressure when the retaining valve is in operation, has eliminated many of the former undesirable features of this method of braking on descending grades. A complete release of brake-cylinder pressure can be obtained without placing the handle of retaining valve in direct release position. This feature is very desirable, making possible the operation of trains over lighter undulating grades without changing the position of the retaining-valve handle. This same feature permits a train to be started with brakes completely released after stopping on a descending grade, which contributes to smoother handling and reduces the liability of slid flat wheels. Experience has proved that the brake-shoe and wheel damage on cars equipped with this form of retaining valve has been greatly reduced when operating on heavy grades.

The short-cycle method consists of making frequent brake applications and short holds, restricting the release of brake-cylinder pressure to a pre-determined rate by use of retaining valves, which allows a sufficient time interval for recharging the brake system before any appreciable increase in speed occurs. If brake applications and releases are properly timed, uniform speed can be very easily maintained and smooth handling will result.

The report was signed by J. A. Burke (chairman), supervisor air brakes, A. T. & S. F.; C. H. Rawlings, general air-brake instructor, D. & R. G. W.; Lee Pearson; A. C. Drye; H. I. Tramblie; J. Mattise, general air brake instructor, C. & N. W.; R. F. Thomas, general air-brake inspector, Canadian Pacific; G. H. Highley, and John Kane.

### Discussion

The discussion was largely in the form of questions which Mr. Burke answered. In his answers he made it clear that no attempt is made to graduate off the brake on a very long train when it gets down to speeds below 15 or 20 miles an hour. When stops are made with a light reduction remaining on a 15- or 16-car train, Mr. Burke said that he would expect the engineman to add a further brake-pipe reduction following the stop before attempting to release, thus insuring a release of all the brakes. With short trains, however, these precautions are unnecessary. On mountain grades, he said, it is necessary to release the driver brakes. He does not advocate this in ordinary operation, however.

## Grates and Ash Pans

The report reviews development of pin-hole grates and advantages of level grates

The report on Grates and Ash Pans reviewed the development of the so-called pin-hole grates with a small percentage air opening, applied horizontally in the firebox, in connection with the burning of low-grade fuels on three western railroads. In the case of the Union Pacific, the report cites a locomotive built with horizontal grates of 70 sq. ft. area and 14 per cent air openings designed to burn a sub-bituminous coal of 8,800 B.t.u., 18 per cent moisture and 8 per cent ash. Older locomotives on this railroad of similar capacity had 45 to 50 sq. ft. of sloping grate with 35 to 45 per cent air openings. On the Northern Pacific the comparison was between locomotives of the same class when converted to burn low-grade fuel by replacing the sloping grate with a grate placed horizontally in the firebox and reducing the air opening from 38 to 42 per cent down to 15 per cent through the small round openings. This change in the locomotives was found to effect an improvement in the burning of the high-grade coals as well as the low-grade coals for which the conversions had been made. This simplified the extending of engine runs by making it possible to burn two or more grades of coal on the same trip.

Another advantage effected by the use of level grates with restricted air openings was the reduction in ash-pan maintenance cost due to the smaller accumulation of burning fuel into the ash pan.

In the matter of fire cleaning, a comparison was made between locomotives with the sloping grates, which could open in only one direction and were difficult to shake, with locomotives equipped with horizontal grates. In the former locomotives the fire bed was 12 in. thick with several clinkers in the grates and 36 min. was required to knock the fire and clean the pan. In the latter locomotive the fire was 5 in. thick with no clinkers and required 11 min. to knock the fire and clean the ash pan. This comparison covered engines running over the same district burning the same kind of coal and handling the same tonnage. The former locomotive, however, burned about four tons more coal than the latter.

### Automatic Draft Control

As a result of an inquiry from the floor, B. C. Bertram of the Lehigh Valley described the automatic draft control system which has been developed and is being extensively applied on that railroad. In principle, this system drafts the locomotive to provide adequate draft for light loads and in starting trains, so that the locomotive would be overdrafted when working heavily at high speeds, except that an automatic unloading valve prevents the back pressure from rising about a predetermined maximum. With this arrangement of draft control grates with 40 per cent air opening are employed, burning egg coal. The maximum back pressure is limited to about 5 or 6 lb. The full opening of the unloading valve, which is a commercial vapor-cushioned type that is free from pounding, in effect increases the exhaust outlet from the equivalent of an 8¼-in. nozzle to the equivalent of a 10-in. nozzle. Mr. Bertram said that the draft control eliminated cinder losses.

The report was signed by M. F. Brown, fuel supervisor, Northern Pacific.

## Oil-Firing Practice

Closed car heaters help to keep fuel dry — A fuel-oil thermometer needed

The short report in 1938 was in the form of a questionnaire. An attempt will be made to summarize this information and apply it to the actual job of firing an oil-burning locomotive. We must still preface this report, however, with the statement that the variation in grade of fuel oil, methods of handling and heating, methods of firebox, burner and air-opening design materially influence the general statements in this report.

### Cracked Fuel in General Use

So nearly 100 per cent of the locomotive fuel oil burned today is cracked that we need not discuss the lighter fuels. In fact, the most of the cracked fuel produced today is cracked beyond the fuel-oil state, then blended back by adding gas, oil or other lighter products. I think that answers Question 1 in last year's report, "Are cracked and heavy fuels now used by all oil-burning roads?"

As to questions 2 and 3, as to whether it is possible to obtain the same quality on all divisions or whether chemical and physical characteristics vary frequently, making it necessary to keep changing instructions: Our better knowledge of the use of cracked fuels has made it possible to instruct in more general terms that will bridge most of the variations in characteristics.

As to Question 4—firing temperatures, 150 deg. F. is not too hot for any of the cracked fuels. Then suppose we start from there and gradually raise the temperature until best results are obtained. A 15-deg. or 20-deg. variation is not serious. The heaviest of the fuels should burn at 180 deg. F., therefore it should not be hard at this time to arrive at a satisfactory average temperature. Now, to help the fireman get over the road, let us turn the engine over to him with the fuel and burning equipment in proper condition.

### Keep Fuel Dry

First the fuel: Fuel soaked with water is no more satisfactory for burning than wet fire wood. If you will keep the fuel dry right to the burner, the saving in fuel will pay big dividends on the cost of closed heater equipment. Practically every specification calls for a dry fuel. The first place that water can be added is when heating in the car before unloading. The nice thing to do is to have closed heaters in the cars. Some of us are still too hard up to reach this happy state, and have to find a cheaper method. A portable closed heater coil on a crane over the unloading track is not very expensive. A closely wound coil small enough to drop through the dome is large enough to do considerable heating. If lowered into the car right over the drain pipes, it will be quite effective in warming the fuel sufficiently for satisfactory unloading, even in below-zero weather.

Unloading and service sumps and storage tanks should have closed heaters. Then, with proper supervision and operation of fueling plants, it should be possible to supply the locomotive with a warm, dry fuel. Two per cent is submitted as the maximum permissible moisture to be allowed in the fuel as it reaches the burner. With the above outlined closed-heater equipment, you will find the average fuel sample at the burner to contain less than one per cent moisture.

Now that the tender tank has been filled with a warm, dry fuel, why spoil it with a open tender heater? Complete the job with a closed heater in the tender.

### Know the Temperature of the Oil at the Burner

The temperature drop from the tender to the burner is variable. The fuel is burned at and beyond the burner, so the temperature at the burner is an important detail to know. The fuel-oil thermometer is now a recognized instrument on an oil burning locomotive. Realize, however, that at the present time only a small percentage of oil-burning locomotives have been so equipped. Why guess at such an important detail when the fuel cost averages around $100 per trip.

### The Fireman's Job

Now let us introduce the fireman and start the trip. The fireman checks the fuel and water tank and other items with which we are familiar. He notes the oil temperature, either by feeling the tank or reading the thermometer. If the oil is not quite up to temperature, he turns on the oil heater so that by the time he is ready to leave the terminal the oil will be at the right temperature. It is important that the blower, atomizer and firing valve be properly regulated during the preparatory time. It is discouraging to a supervisor to note a locomotive standing with too much atomizer, or blower, smoking or gassing. Soot may be forming in flues or on front-end netting. Drumming is hard on brick work.

After starting the blower should be shut off. There is no value in wasting steam through a 1-in. or 1½-in. line. At the beginning of the trip, feel out the atomizer and note the opening of the atomizer valve; that is one-quarter turn, one-half turn, or more. The best way to determine the best atomizer setting is to watch the fire through the peep hole. When the fire is steady, white, and does not tend to come out the fire door, the atomizer is about right. Then look at the stack, and if it is not clear try a slight adjustment one way or the other. For the rest of the trip it should not be difficult to adjust

the atomizer slightly from time to time to meet the varying conditions.

As a rule a heavy atomizer will cause drumming, overheating of firedoor, carbon formation on flash wall account too much fuel in back of fire box and not sufficient air to burn it. Too light an atomizer will permit the forced draft to turn the fuel back, causing too great a proportion of the heat in the front end of the fire box, or when standing permit the fuel to drop, setting fire under the engine or building up carbon on the floor of the furnace. Note the fuel temperature frequently.

Just before starting the trip the boiler pressure should be at the maximum and water perhaps slightly above normal. Then do not try to force the fire and feedwater pump at first. The brickwork and firebox are not thoroughly heated. If there is plenty of water in the boiler, the pump can be worked lightly a mile or two to give the firebox a chance to warm up. An oil-burning locomotive is very sensitive to water-pump operation. Get into the habit of opening or closing the pump throttle a very little at a time. Large changes in pump throttle mean flooding or starving the boiler of water, with resultant excessive fluctuations in steam pressure. Know the road and watch the engineer. Change the firing valve and pump a little at a time to compensate for change in engine throttle or cut-off. Always have plenty of water to be safe, but remember that high water lowers superheat temperature, interferes with valve and cylinder lubrication and increases fuel and water consumption.

### At the End of the Trip

If the fireman is doing a good job of firing, he should be the best authority at the end of the trip as to just what work, if any, should be done on the firing equipment. At the end of the trip look in the firebox to see if the fire has been dragging on the floor of the furnace, burning on one side or throwing the fuel too high. The color of firebrick and firebox sheets will tell whether or not the temperatures have been fairly uniform throughout the box. A dull gray color on firebox sheets means the ash of soot, or a high temperature to burn the soot on the sheets. A black color means unburned soot, or a medium temperature. Dried-up or sticky fuel means a low-temperature spot. Be helpful and report these conditions, with your opinions as to firing or steaming. The enginehouse men need your help and you want them to understand, so that the locomotive will be in condition for a good trip next time. Team work counts.

The report is signed by R. S. Twogood, fuel engineer, Southern Pacific.

## Present Influence of the AB Freight Brake

### A method of controlling slack in high-speed freight service with modified H-6 brake valve

The percentage of AB valves, now in service is not great enough to insure the full benefits being derived from important design features. I have particular reference to the positive application and assurance of release with minimum service reductions, the ability to obtain a prompt emergency application following a substantial service application or a release, and a prompt release following an emergency application. As the proportion of AB valves in trains increases, there will be a proportionate improvement in overall train performance. In connection with this, recent check was made of 50 trains as to the proportion of AB valves, which was found to be 20 per cent.

### Keep High Standard of K Triple Maintenance

We will be faced with the necessity for maintaining K equipment in first class operating condition for several years to come; and if these are to be successfully operated in comparatively long trains and associated with AB equipment, our standard of maintenance must not be lowered simply because it is no longer considered a standard for new equipment.

As the train lengths are increased, the rate of brake-pipe pressure change, during an application or release, becomes increasingly slower and few appreciate what the condition of a triple valve must be to respond properly to these slow changes in pressure. Many railroads make repairs at outlying points which do not afford the equipment necessary. It has been found that improper lengths of feed grooves, elongated exhaust ports, distorted piston heads and shanks, filed piston shanks, short graduating stems, and many other similar operations, classed as improper repairs, can be traced, in most cases, to methods used in these outlying districts.

The quality of workmanship in making repairs should not be based on a minimum permissible limit at which valves may be returned to service; but all railroads should follow the example set by a few, and improve their repair standards to a point which will meet the more exacting requirements of modern long train service. The difference in cost of making repairs which are comparable to the air brake manufacturer's standards and those which will just pass test rack requirements is very small in comparison to the many benefits derived.

The Air Brake Manufacturers have spared no expense in building the new AB equipment to standards which will satisfy present and future operating requirements. It is, therefore, our responsibility to see that these standards are maintained in order that the railroads shall obtain its full operating benefits.

As an example, the precision to which the slide-valve faces and seats, also piston bushings were originally finished, is such that only the most modern methods for effecting repairs can re-condition the valve to its original standard.

At the time the AB valve was developed, considerable study was directed to suitable maintenance of operating standards. To determine this quickly and efficiently the AB test rack was developed to ascertain if the valves comply with proper standards of operation and workmanship, and if not, wherein they deviate from such standards. The test sequence is such as to point out a defect in order that proper repairs may be accurately made. The rack is compact, accessible to the operator from one position, and requires a minimum of maintenance. The use of diaphragm cocks, of the cam-lever opening type, and a water column for accurately measuring pressure differentials are but examples of details which make the rack a very accurate means for determining the desired standards.

Due to the extension of time between cleaning periods, more effective means are required for excluding moisture and other foreign substance from the brake pipe in order to insure that feed grooves and other charging ports will

not become unduly restricted. A pump intake filter of high efficiency in intercepting even the finest particles of dust, is an important item in the general air brake system. The benefits derived are not alone confined to the brake system, but the service life and dependability of operation is greatly extended. Efficient means for filtering all air leading to the vital operating parts of the AB valve insures continued lubrication of the packing rings and eliminates the development of high friction.

Of major importance is the problem of properly cooling the compressed air, employed in the brake system. It is important that the air be cooled to as near the surrounding atmospheric temperature as is possible, and yet avoid undesired freezing in the cooling system during extremely cold temperatures. Double pump installations, maintained at high efficiency, are important aids to the elimination of moisture in the brake system.

Brake pipe leakage has always been a very pertinent subject, and the successful handling of long trains only serves to point out the necessity for continued efforts on our part to reduce it to a minimum.

### Importance of Time Element in Adjusting Slack

Slack action is the major cause of damage to equipment and lading. While it cannot be entirely eliminated; it can be controlled so as to avoid material damage. The successful handling of freight trains involves a gradual re-adjustment of train slack; and is equally important during the starting and stopping. Train slack cannot be changed quickly and at the same time smoothly. Time element is a very important factor in all forms of brake operation; and its relation to other functions becomes more important as the train lengths are increased.

The slight time advantage gained by the use of release position during initial charging as compared with the use of running position only when employing a modern high capacity feed valve properly installed with minimum piping between main reservoir and feed-valve bracket, and feed-valve bracket and brake-valve bracket is invariably offset by the time required to insure the release of reapplied brakes. Actual tests have demonstrated that brakes which have reapplied back in the train a distance of 20 cars or more cannot be positively released by a flash kick-off without danger of causing more brakes to reapply at the forward end.

Overcharges are positively eliminated by the use of running position only and many railroads have issued instructions to eliminate the use of release position entirely. The use of running position only avoids the direct passage of moisture to the brake pipe, such as will invariably occur should reduced air, at the high relative humidity, be admitted directly to the system during the initial part of train charging or during a release period.

It has been found that the freight train handling instructions as contained in Air Brake Association Book No. 8 can be successfully used, producing the desired results, with but a few exceptions and these perhaps where because of out of ordinary conditions it may be necessary to cover the condition by special instructions.

### Controlling Slack with the Brake

When designing the AB valve the transmission rates for both service and emergency functions was materially increased in order to reduce to a minimum the ill effects of damaging slack action. The full benefits of this design feature will become more apparent as the percentage of AB valves in a train increases. With the average of 20 per cent of AB valves per train, however, the advantages of the AB valve features is very noticeable, especially in regard to service application and release of brakes.

Because of this we have instructions, with trains of 75 cars and under, to release whatever brake-pipe reduction there is at the time the brakes are to be released. That is if a 6-, 7- or 8-lb. total brake-pipe reduction is sufficient to accomplish the desired result this reduction is released without the necessity of having a definite total reduction to assure release that heretofore was thought necessary. We are now using the brakes for slack control at all locations that slack action usually occurs without reducing the speed and, of course, we are using the brakes for definite speed reductions as well as stops.

On the Missouri-Kansas-Texas short high-speed trains of 75 cars and under are very difficult to handle. The road characteristics are such—hog backs and curves—that while the effort is being made to operate at high speed the slack action is so severe that it cannot be tolerated. We now use the brakes for slack control. Our freight train handling instructions are, in part:

"A—Considering all factors that enter into safe train handling, it will be necessary to discontinue drifting wherever possible and resort to the use of pulling throttle against brake application. This can be done as per item B. Wherever grade conditions are such that the methods in item B cannot be used and it is necessary to drift this must be done at a lower rate of speed."

To control the train at high speed for safe operation and to control the slack action at such location where it will run hard and where no definite speed reduction is involved, the following operations are used:

"B—Use a pulling throttle. Have the slack all out. Make the first reduction 6 lb. Keep the locomotive brake from applying through the entire operation, and while the brake-pipe service exhaust is discharging open the throttle three or four notches in order to have the locomotive pulling harder while the brakes are applying. Use this brake application until the results have been accomplished. When ready to release, place the brake-valve handle in running position, leaving it there. In case the speed increases, make another light reduction."

At locations where a definite speed reduction is to be made the following operations are made:

"C—Use a pulling throttle having the slack all out. Make the first reduction of 6 lb. Keep the locomotive brake from applying throughout the entire operation, and while the brake pipe service exhaust is discharging open the throttle three or four notches in order to have the locomotive pulling harder while the brakes are applying. After the service exhaust ends, gradually reduce the throttle to a light pulling throttle. If necessary, make a few additional light reductions 2 lb. at a time. When ready to release the brakes, place the brake valve in running position; at the same time reduce to a light drifting throttle."

When making stops we use the following operations:

"D—Use a pulling throttle. Have the slack all out. Make the first reduction of 6 lb. Keep the locomotive brake from applying at this time, and while the brake-pipe service exhaust is discharging open the throttle three or four notches in order to have the locomotive pulling harder while the brakes are applying. After the brake-valve exhaust ends, reduce to a moderate pulling throttle, easing off if necessary to maintain this. If necessary, make additional light reductions of 2 lb. Then, when within 8 or 10 car lengths of being stopped, use sand continuously. When within 40 ft. of being stopped, make a reduction of 6 to 8 lb., allowing the locomotive brake to apply and shut the throttle, having the brake-valve exhaust open when the train stops."

The three above operations described are used with all make-up of trains except with the heavy loads behind. With such train make-up we reduce to a light drifting throttle before the brake application as per item A.

We believe the freight-train handling instructions, as

contained in Air Brake Association Book No. 8, are ideal for freight-train holding and are used by us with very goods results. We only deviate from these instructions as regarding the total reduction to be released and the use of running position for releasing and charging. We also believe that with the above methods of train handling advantage is taken of the AB brakes in the train in the direction of expediting train movement with safety.

### The Modified H-6 Brake Valve

To simplify the engineer's work in connection with train handling, we have modified our H-6 brake valves in such a manner that we now have a first service position and when used will make a 6 lb. brake pipe reduction and at the same time hold off the locomotive brake when the first reduction is being made. This will free the engineer to the extent that he can add to the throttle three or four notches while the brake-valve exhaust is discharging. Also changes in this brake valve give feed-valve pressure on top of the rotary valve with the brake-valve handle in release and running positions. Release position is used to release the brakes as this position gives full feed valve capacity whereas running position will choke down the valve capacity in order to give the conductor's valve proper control of the brake pipe. With this design, when releasing the brake valve is placed in release position 3 or 4 min. (without overcharge) and then returned to running position. This position, as above stated, will give control of the brake pipe to the conductor's valve.

The report was signed by W. E. Vergan, supervisor air brakes, M-K-T; J. H. Henley, road foreman engines, M-K-T; W. H. McCune, road foreman engines, M-K-T; A. H. Rothmeyer, road foreman engines, M-K-T; and S. L. Farney.

### Discussion

In answering questions in the discussion Mr. Vergan, who presented the report, said that the modified H-6 brake valve was not intended to replace the No. 8 brake valve. He insisted, however, that if he were to apply the No. 8 valve it would have to provide an automatic lap at 6 lb. brake-pipe reduction just as does the first-application position in the modified H-6 type. It would also have to include the feature of the modified H-6 valve which prevents the application of the locomotive brake in first-application position.

Questions were raised as to the effect on fuel consumption of the use of the brake against the throttle. Mr. Vergan said that when slack developed in a freight train operating at high speed on track none too smooth, the vertical bouncing of the cars tends to cause the couplers to separate. He attributes the steady reduction in fuel consumption in freight service on the M-K-T to the reduction in break-in-twos which has eliminated the many delays formerly encountered. He referred to a reduction from as many as 125 knuckles in 30 days to five or six per month.

In replying to questions concerning the sticking of brakes following release from 6-lb. brake-pipe reductions, Mr. Vergan said that particular care was taken on the M-K-T to maintain tight brake pipes. Every car, at the principal terminals, he said, is tested with a portable test truck taking 20 cars at a time. He also stressed the statement in the report that an average of 20 per cent of the cars in M-K-T trains are equipped with AB brakes. Without the effect of these brakes in the train he said it would be impossible to handle the trains in this manner.

Mr. Vergan said that the modified H-6 brake valves are fitted with high capacity feed valves.

## Stationary Boiler Plants

### Consumption sufficient to justify detail study of plant designs

At many railway terminals an hour by hour study of steam, compressed air or power requirements may show a very uniform demand. Where the demand is fairly uniform it may almost be taken for granted that the base load represents standby losses. Radiation losses from steam lines, leaks, pumps or equipment operating continuously, whether needed or not, cause the uniform base load. A reduction or elimination of these wastes means a smaller but less uniform load on the power plant. If a new plant or replacement of main equipment in an existing plant is under consideration, a load study may make it possible to specify smaller units than would otherwise be considered. Steam used to operate boiler, washing and filling pumps, blower for firing up locomotives, fueling plants, etc., cause a very intermittent and variable load on a stationary boiler. Boiler equipment should, therefore, be designed to operate efficiently under a variable load.

The boiler, furnace and burning equipment should be designed for maximum efficiency during the medium load carried a long period of time and yet be able to carry the peak load, even at a light sacrifice in efficiency. This will probably be found better than to pay for the standby losses of an extra unit required but a few hours per day.

To express it in a little more detail: Far more than one boiler horsepower can be produced for each 10 or 11 sq. ft. of heating surface without damage to the metal if the right boiler with ample circulation, etc., is selected. If 10 or 11 sq. ft. of heating surface is provided for each boiler horsepower of normal load, there is no reason why two, three, or even four boiler horsepower cannot be generated for each 10 or 11 sq. ft. for short periods. The same is true of the furnace volume, grate area, etc. In some plants boilers should be designed to carry 150 per cent of rating peaks, and in others 400 per cent of rating.

A few years ago the majority of railway power plants burned coal in hand or stoker fired furnaces. Today natural gas, oil, pulverized coal, have come into general use. The market is flooded with new burning equipment for all of these fuels. The majority of this equipment may give excellent results if installed with the right boiler for certain load conditions. This merely makes the power plant man's job more interesting in the design and selection of equipment that will produce the best results at a given terminal at the least over-all operating cost.

If the average railroad burns from 8 per cent to 12 per cent of its fuel under stationary boilers, the total bill is sufficient to justify a detail study of new plant design or existing plant rebuilding.

The report was signed by R. S. Twogood, fuel engineer, Southern Pacific.

# Why Not Streamline Statistics?

## Suggestions for bringing out their pertinence in tables and by graphic presentations

Statistics, as a general class of product, in the typical statement form in which they are usually presented, are for the average man unattractive to the point of boredom if not to the extent of actual repulsion. The natural result of this situation is that the unhappy victim who must wade through a periodical deluge of such statements is inclined to avoid the journey or postpone the effort as long as possible, then plunge in and hurry through with all possible speed to more congenial mental territory beyond. Even to the statistically minded man it is too often the case that important relationships are so obscured and disguised that it is difficult if not impossible to discover and assign to them their actual or relative values. It is small wonder, then, that the laborious accumulation and marshaling of statistical data so often serves little of the intended purpose.

The general purpose of keeping records that permit the development and presentation of statistics at regular intervals on any subject under study is to show where we stand at any present time with reference to where we have been in various periods of the past and thus to determine the trend or direction of our progress, and if the operating officer is to be enabled to make any consistent use of such information as a guide in the formulation of plans designed to effect improvement in performance it is essential that the statistics that show the trend of performance be supplemented by other data that develop what are the causes responsible for the changes that may be observed in the trend of performance. It is well understood that data recorded for use for this purpose should be (1) pertinent, (2) accurate, and (3) promptly available.

But after we are assured that our material has been prepared in accordance with these principles, it is a commonplace observation that plain columns of figures paint no adequate picture of the subject under consideration even when there are no complicated inter-relations between the corresponding values in the different columns that may have been set up on a statistical statement. Of course, this deficiency is emphasized many fold when complicated interrelationships exist, as they surely do between the various factors represented in statistical presentations of locomotive fuel performance.

Fig. 1 shows an example of charting for a two year period of the monthly values of five factors of outstanding importance in their influence on the operating results of a railroad division: (1) Volume of business in million gross ton miles, (2) average temperature (on reversed scale), (3) average gross tons per train, (4) average engine load in gross ton miles per engine mile, and (5) average engine miles per 100 freight train miles. Correspondingly the monthly values of two factors representing important results of operation, are also shown: (1) Freight service fuel performance, pounds of coal per 1,000 gross ton miles, and (2) freight-train wage and fuel cost per 1,000 gross ton miles.

It requires only a glance at the chart to discover the extremely close correspondence between the volume of business on the one hand and the average train load and engine load on the other hand, between the engine load and the temperature on the one hand and the fuel performance on the other hand, and between all these factors and resulting wage and fuel cost per 1,000 gross ton miles.

It is particularly interesting to note the effect of unusual happenings upon all the factors and results of operation as shown by these charted values for the months of April and May, the period of the latest cessation of coal loading. This is the sort of presentation of statistical values that makes them tell a connected story, which the operating official who is studying his performance, can readily interpret with assurance that the comparative values and the relationships of the various factors have been properly appraised.

And now that there is a growing general appreciation of the value of form design, undertaken with the purpose of increasing the eye appeal of objects in general, particularly now that it is becoming almost standard railroad practice to streamline new locomotive and car equipment to attract the patronage of the traveling public, possibly the suggestion that we do what we can to "streamline" even so unattractive an object as the

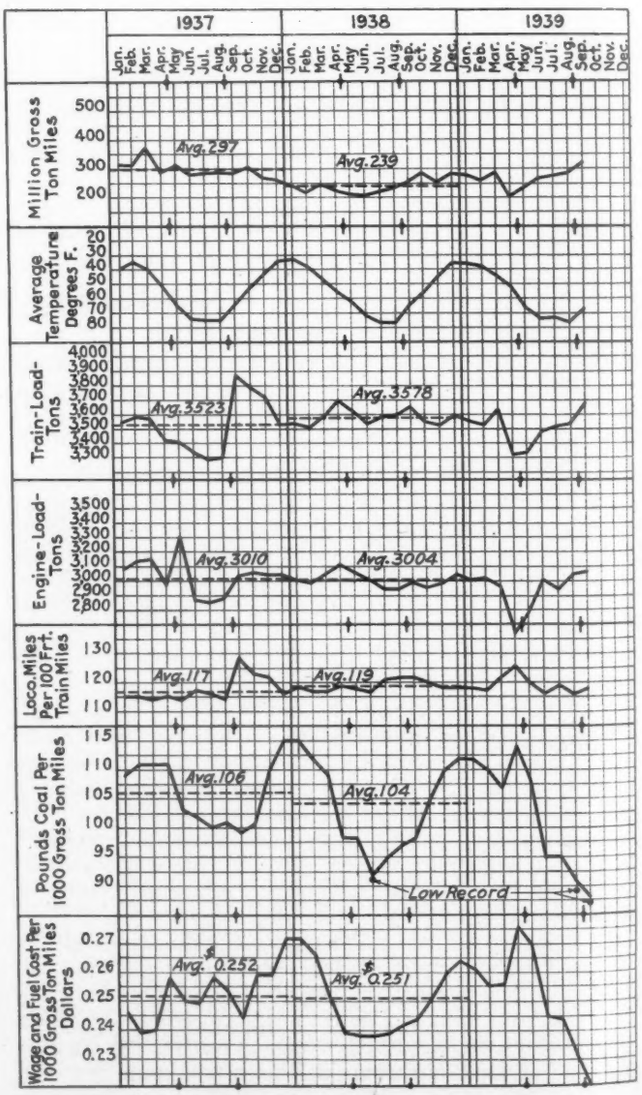



**Fig. 1—Example of the method of charting five outstanding operating factors over two-year period, and two monthly factors**

average statistical statement to make it more acceptable to its students may be found to be less flippant than it sounds at first mention.

By this proposal we mean simply to indorse the well-known principle that the average eye readily recognizes with accuracy the relative proportions of objects placed near together, which applies with particular force to such objects as parallel lines drawn on a scale diagram. We propose to advocate a more extensive use of graph-

**Table I**

| From X | To Y | Service | No. trains | Train load | Engine load | Lb. coal per 1000 g.t.m. |
|---|---|---|---|---|---|---|
| | | Scheduled | 8 | 4042 | 3126 | 87 |
| | | Scheduled | 2 | 2941 | 2941 | 158 |
| Total | Eastbound | Scheduled | 10 | 3901 | 3106 | 94 |
| | | Scheduled | 4 | 3606 | 2386 | 128 |
| | | Scheduled | 1 | 2915 | 2915 | 153 |
| Total | Westbound | Scheduled | 5 | 3516 | 2433 | 130 |
| | | Tonnage | 3 | 7118 | 5297 | 64 |
| | | Tonnage | 2 | 9730 | 9730 | 45 |
| Total | Eastbound | Tonnage | 5 | 7855 | 6300 | 58 |
| | | Tonnage | 5 | 2914 | 2914 | 125 |
| | | Tonnage | 2 | 3331 | 2258 | 157 |
| | | Tonnage | 1 | 2374 | 2374 | 123 |
| Total | Westbound | Tonnage | 8 | 2830 | 2624 | 131 |
| Total | Scheduled and tonnage | | 28 | 4148 | 3357 | 96 |

ical charts on which lines drawn to scale, or points set down to scale and connected by lines, are used to represent numerical values taken from the statistical statements. Without doubt, such graphical methods of presentation promote quicker visual comparisons of values, easier understanding of variations and stronger impressions of relationships than do the methods of simple tabulation that are in more general use. It follows that a corresponding saving of mental effort and time is thus accomplished for the busy officer who can hardly be expected to take time out for exhaustive analysis of statistical material.

In Fig. 2 we show an example of a divisional daily report of performance in freight service based upon the tabulation of values only, but employing a form of tabulation that has been made as attractive as possible by means of careful selection of both the factors or items covered and the comparisons that are set up.

It may be observed that the comparisons of the various items or performance factors for "This Date," "This Month to Date," "Last Month to Date," and "This Month Last Year to Date," constitute quite a complete analysis of the day-by-day operation of a division which may be grasped at a glance by the officer familiar with the territory.

But even so, we would advocate the use of the graphical method for showing the continuity of the daily values and the moving averages as they are published from day to day on even so well designed a tabular statement as this. While we have no knowledge of the regular use of such a chart we present in Fig. 3 a representation that we have prepared to illustrate the appearance of a month's data on Engine Load and Pounds of Coal per 1,000 Gross Ton Miles when set up in this form. From similar charts for preceding months laid side by side the comparisons with "Last Month" and "This Month Last Year" could be made at a glance.

In Table I, we show the next step in the analysis which the divisional officer would logically wish to make for occasional selected days, i.e., the performance of the groups of trains in each of the classes of service that make up his operation. In such a simple tabulation as this the contrasts in train load, engine load and unit fuel

THE BALTIMORE AND OHIO RAILROAD COMPANY

DAILY LOCOMOTIVE FUEL CONSUMPTION

East End Cumberland Division For September 30 193 9

| Class of Service | Performance—This Date: Amount in Tons Actual | Amount in Tons Standard | Per Cent. Efficiency | Cost in Dollars Actual | Cost in Dollars Standard | This Month—To Date: Tons of Coal Actual | Tons of Coal Standard |
|---|---|---|---|---|---|---|---|
| Passenger | 180 | 150 | 83.5 | 349 | 291 | 4732 | 4263 |
| Freight | 533 | 485 | 91.0 | 1034 | 941 | 14260 | 12930 |
| Yard | 87 | 79 | 91.0 | 169 | 153 | 2266 | 2056 |
| Total All Classes | 800 | 714 | 89.3 | 1552 | 1385 | 21258 | 19269 |

Terminal Div. Coal Included In Yard ... Tons. Month To Date: Tons | Average Price per Ton $ 1.94

OPERATING FACTORS AFFECTING FUEL CONSUMPTION

| Description | Accumulative Data: This Date | This Month To Date | Last Month To Date | This Month Last Year To Date |
|---|---|---|---|---|
| Gross Ton Miles in Thousands | 15941 | 320201 | 274491 | 251647 |
| Net Ton Miles in Thousands | 7826 | 153997 | 128442 | 113101 |
| Total Freight Train Miles | 4067 | 86288 | 77606 | 68985 |
| Total Freight Engine Miles | 4544 | 104481 | 90080 | 84090 |
| Total Freight Train Hours, Crew Time | 349.9 | 6885.8 | 5806.4 | 5400.5 |
| Total Tons Freight Coal Consumed | 533 | 14360 | 12728 | 12532 |
| Average Temperature | 70 | 67 | 75 | 65 |
| Passenger Locomotive Miles | 2607 | 71442 | 72451 | 69648 |

Program Fuel Unit—Pounds Coal Per Thousand Gross Ton Miles 97

UNIT VALUES — FREIGHT SERVICE

| Description | This Date | This Month To Date | Last Month To Date | This Month Last Year To Date |
|---|---|---|---|---|
| Pounds Coal Per 1000 Gross Ton Miles | 70 | 89 | 93 | 100 |
| Ton Miles Per Hour, Crew Time | 43660 | 44800 | 47270 | 44090 |
| Average Train Load—Gross Tons | 3743 | 3627 | 3537 | 3648 |
| Average Train Load—Net Tons | 1934 | 1744 | 1655 | 1840 |
| Average Engine Load—Gross Tons | 3354 | 3565 | 3048 | 2993 |
| Av. Speed in Miles Per Hour, Crew Time | 11.6 | 12.8 | 13.4 | 12.8 |
| Cost Per 1000 Gross Ton Miles | .467 | .609 | .685 | .682 |

This Summary to be compiled daily and one copy sent to each of the following:
Fuel Engineer, General Superintendent, Division Superintendent, Supervisor Locomotive Operation, Master Mechanic, Road Foreman of Engines, Train Master, Chief Train Dispatcher

To be mailed not later than the 4th day after the date of the report. Date Mailed— 10-5-39

Fig. 2—Divisional daily report of performance in freight service, using tabulations only

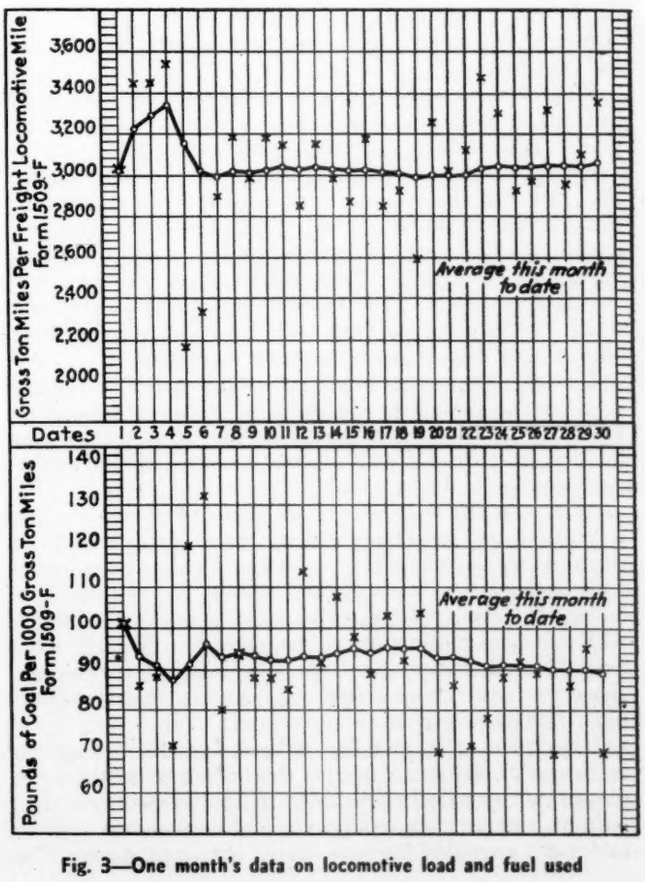



Fig. 3—One month's data on locomotive load and fuel used

consumption, as between different groups, is sufficiently striking without the use of graphical charts. It becomes obvious that certain groups may be selected for special attention with the object of improving the general average, in which case the analysis would naturally be carried down to expose the performance of individual trains.

We consider it important to emphasize the opinion that, no matter how attractive the presentation may be made, there is only a very limited value to be derived from statistical data as guides to control of current trends of operating performance if they are not made available within a few days after the date or after the close of the period they cover. While statistical statements published five to eight weeks after the period may be useful and necessary as records of past performance, as, for example, is the case of the O. S. Reports to the Interstate Commerce Commission, it is obvious that they are not available early enough to be used to influence current trends of operating performance.

The report was signed by E. E. Ramey (chairman), fuel engineer, B. & O.; G. E. Anderson, general fuel supervisor, Great Northern; P. E. Buettell, fuel supervisor, C. M. St. P. & P.; A. A. Raymond, superintendent fuel and locomotive performance, N. Y. C., and E. G Sanders, fuel conservation engineer, A T. & S. F.

# Preparation, Inspection and Utilization of Coal

## Washing improves many coals—Make thorough mine inspections—One coal per engine district

In recent years careful preparation has become the rule in the coal industry. Decreased demand for coal because of slackened industrial activity and the inroads of competitive fuels have forced upon the coal industry the need of dressing up the product. Of necessity the alert producer must keep up with progress in coal preparation. Great forward strides have been made in the last two decades. Today coal is washed, dried, sized, dust-proofed, medicated and inspected so as to insure the consumer the maximum in quality and uniformity for his fuel dollars. Care is taken in every step of preparation from the initial loading until the finished product is lowered into the railroad car. Each step is important.

### Preparation

Coal preparation at the tipple may be classified into the following sub-divisions: sizing, cleaning or removing of impurities, surface treatment to allay dust, and mixing and blending.

Most tipples are equipped with elaborate screening and rescreening installations such as high- and low-speed shaker and vibrator screens, special conveying and assembling equipment, picking tables and loading booms. The raw coal is fed on to screens for separating into various sizes; namely, block, lump, egg, stove, nut, pea, screenings, duff, modified mine run and various resultant sizes. In addition to these grades some of the mines are equipped with storage bins and mixing conveyors which enable them to load almost any size or combination of sizes that a consumer may demand.

The concentration of the industry on preparation of ideal stoker coal sizes has brought about a number of developments in screening equipment. Reasonably satisfactory screening of coal at sizes as small as forty-eight mesh has been made possible.

After having been separated into different sizes coal is subject to breakage in both hand and mechanical cleaning plants, therefore, modern tipples are equipped with degradation screens to remove this breakage of undersized coal. Many of the mine tipples are equipped with crushers and cross conveyors. This is particularly desirable when mines are supplying railroad fuel to purchasers of run of mine coal who specify that the lumps must not exceed a maximum top size.

Hand-picking is still the method by which most coal is cleaned. Where it is the sole cleaning method employed, all prepared sizes down to approximately 1¼-in. bottom size are generally cleaned. Separate picking tables are provided for each of the prepared sizes. Most plants having mechanical cleaning equipment still rely on hand-picking for the larger sized coal above four or six inches. This is because it is easier and more economical to remove the larger sized visible impurities in this manner.

It has been found that mercury vapor lamps increase the contrast between sulphur pyrites and pure coal. Therefore, this type of illumination is in extensive use for picking coal in which pyrites are common. On the other hand, the light from mercury vapor lamps tends to deaden the lustre of coal so that slate appearing with the coal does not stand out as clearly as when incandescent lamps are used. The character of the impurities determines which type of picking-table illumination is more efficacious.

Sized coal is delivered to the railroad cars from modern loading booms with the minimum of degradation. A new feature built on the end of the loading booms still further guards against the breaking up of coal as it falls in the car. This feature consists of two flat steel aprons so mounted at the end of the loading boom that the coal slides down into the cars. Another improved method now being used successfully is layer loading, which is a new departure from general loading practice. Layer loading consists of loading two or three cars in tandem, which materially reduces segregation and makes possible greater uniformity of coal quality.

Competition with oil and gas in the domestic market and keen competition within the coal industry has caused many producers to install equipment in the tipples to spray coal with various kinds of dust-allaying media. A number of industrial plants are specifying dust-treated coal. The railways as a whole have not given this subject serious consideration although one or two companies, such as the Richmond, Fredericksburg & Potomac, have conducted some investigation in this direction.

There are but few mines that are equipped to mix and blend coal. Unfortunately run-of-mine coal from the same mine or different mines does not run uniformly as to size. Appreciating this condition some of the operators have installed storage bins and mixing conveyors to insure uniformity of size in every car of coal shipped.

An addition to the efficiency of preparation that is typical in the industry today is mechanical cleaning. The advantages claimed for such a refinement are many and varied. Any reduction in ash content represents a corresponding increase in heat value. The benefit to the consumer is considerably greater than the apparent increase in heat value. The burning characteristics of

washed screenings may be different from the same coal in the raw state. Less slagging, maintenance, and boiler outage with washed coal is the experience of many stationary boiler plant operators.

A very important advantage of washing coal is the relative uniformity of the product. The ash content of raw screenings will often show wide variations from the average from day to day. Lack of uniformity is expensive to the coal user because few types of burning equipment have the flexibility necessary to burn successfully alternately low- and high-ash coal. Excess ash or low heat value may mean that a plant must shut down because of inability to carry the steam load.

Some coals cannot be economically washed. The structure of the coal and the impurities inherent and extraneous, vary not only with each coal seam, but also with each mine and within each loading day. Modern automatic washing units, because of their great flexibility, can successfully clean our midwestern coals to a reasonably uniform desired ash content. Because of the concentration of impurities in the small sizes of midwestern coals, washing reduces the ash in the small sizes to a much greater degree than it does in the prepared sizes. In some coals, the ash content of the screenings after washing is less than the ash content of the larger sizes. In making the decision to wash a particular coal, the percentage of ash desired in the washed product must be decided. The character of the impurities and intermediate coal may determine this.

To emphasize the benefit derived from washing 1¼-in. screenings, the following are averages of several analyses made on three Illinois group mines designated as follows:

| | Ash, per cent | | Sulphur, per cent | | B.t.u. | |
|---|---|---|---|---|---|---|
| Classification | Raw | Washed | Raw | Washed | Raw | Washed |
| High grade ..... | 11.50 | 7.96 | 1.99 | 1.03 | 12,590 | 12,900 |
| Medium grade ..... | 12.38 | 9.61 | 3.40 | 2.81 | 12,440 | 12,890 |
| Low grade ..... | 16.71 | 7.69 | 3.94 | 2.09 | 10,260 | 12,260 |

The increased use of mechanical loading devices in underground mines and the rapid growth in strip-mine operations has made mechanical cleaning of coal practically mandatory. Such mining methods not only load all the impurities contained in the coal seams, but in many cases also part of the roof and the clay or rock bottom. It requires heavier shooting in order to break down the larger lumps of coal and consequently produce a tipple mixture with which hand picking methods cannot hope to cope. There are also certain seams where even if the coal were hand loaded, the size and the distribution of the impurities make it next to impossible to properly clean the coal by hand. It is here that the mechanical cleaning process must step in. As far as the purchaser is concerned, the end results of mechanical cleaning methods are about equal. Practically every different cleaning system will produce the same grade of coal from any certain coal seam.

It would seem as though a new series of tests on washed fine coal such as 2-in. and 1¼-in. screenings would be helpful in pointing the way to the increased use of fine coal. Since mechanically cleaned coal is practically dustless there should be a reduction in honeycomb formation on tube and blue sheet, less ash to dispose of from the fuel bed, less handling at the cinder pit and less unburned coal passing through the boiler and out the stack.

With the use of mechanically cleaned coal smaller than 7 in. by 0 or 6 in. by 0, such as 2 in. by 0, segregation is further reduced with beneficial effects. If 2 in. by 0 coal was supplied exclusively to stoker-fired locomotives the degradation in passing through the stoker delivery apparatus would be materially reduced.

A problem that naturally follows the washing of coal is the treatment of the screening sizes to remove excess water which is objectionable for a number of reasons. First, the user does not want to pay for water that detracts from rather than adds to the evaporation efficiency. During the winter it is important to remove excess moisture in order to prevent freezing. The practice of dewatering washed coal is far from being standardized. There are no two preparation plants that meet the problem of dewatering in exactly the same manner. The absence of uniformity in dewatering equipment would seem to indicate that the question of dewatering is not a settled one.

Most plants equipped with washers supplement mechanical dewatering and drying of screenings with the addition of calcium chloride or granulated salt in extreme cold weather. The remaining extraneous moisture in the fine sizes after dewatering is concentrated through gravitation to the bottom of the railroad car. Difficulty is sometimes encountered in zero weather in opening the pockets of hopper cars because this concentration of moisture in the pockets results in freezing. This freezing does not occur when ⅜ in. or 5/16 in. down is heat dried. At plants not equipped with heat driers the addition of a chemical agent such as calcium chloride in the bottom of the pockets may prevent freezing.

## Inspection

It is understood by all of the railroad fuel inspectors and fuel inspection departments that the proper place to inspect coal is at the mine, and that it is necessary to be familiar with the mine's operation, preparation facilities and practices so that intelligent decision can be made as to what to expect. Such inspections should be thorough. In other words, the coal inspector should spend a whole day at various times going through a coal company's plant and observing every detail of operation. He will thereby make the contacts and see enough of the coal to be able to tell definitely what quality it is. This is far better than spasmodic inspection at the mine or on the tops of cars, or a few unloaded cars at destination. With this knowledge the inspector knows what mines may have difficulty in furnishing satisfactory coal either from the standpoint of their mechanical equipment above or because of their method of loading the coal underground. Coal not complying with contract requirements or specifications should be rejected and the reason for rejection given. Good inspection entails surprise visits. Therefore, the inspector should not be required to follow any set routine, which will hamper him in the proper functioning of his duty.

As it is physically impossible to have a large enough inspection force to see every car from every mine during each mine's working day, much can be accomplished by having the coal-chute, stationary boiler-plant and roundhouse foremen report on the coal. If it seems to fall short of the specifications, then a sample of the impurities found should be collected and saved for the inspector so that a proper investigation can be made at the mine. Reports to the inspectors or fuel department headquarters on such inspections and samples collected have much to do with the elimination of stoker failures, steam failures and fuel losses which otherwise might be overlooked.

The sampling of coal is something that should be done with great care. Incorrect sampling or spasmodic sampling of coal does more harm than good. As has already been said, the best place to sample coal is at the mine. Any coal operator who will not co-operate in this respect is not a good producer of coal, no matter what his product is like. At large mines and where they have

cleaning plants, provision is usually made for automatic sampling. If a sample of the complete day's run at the mine is taken, it will usually show a true representative analysis of the mine's average coal quality. Most operators having cleaning plants or large tipples, usually make provision for collecting samples of daily runs and in most cases, collect them for their own information. It is only necessary to co-operate with the producer in order to get a portion of his sample.

The inspectors must keep a close check on the coal cleaned in a mechanical cleaning plant because these plants can be adjusted to produce any desired ash percentage above a given minimum. When the cleaning control adjustment is changed, it means an increase or decrease in ash percentage, that is the impurities loaded out with the coal.

Foreign material is occasionally thrown on top of the loaded coal cars while enroute and it is possible for this foreign material to become mixed with the coal. Therefore it is necessary to make top inspection of each load before the unloading process is started then to watch the car's contents as they are being unloaded. This care reduces possible failure and expensive breakdowns of mechanically operated devices on our locomotives and in our stationary boiler plants. The coal chute and boiler room attendants should be instructed to make these inspections.

### Utilization

Fuel used by railroads is normally from coal fields near at hand or coal which is most easily and most economically obtainable. Owing to these considerations practically every variety of coal available is used to greater or lesser extent by the railroads. If all coals were similar in physical and chemical characteristics and if locomotives and stationary boiler plants were designed to burn all sizes and kinds of coal with equal combustion efficiency, selection of locomotive and stationary boiler plant fuel coal would be greatly simplified. The methods employed by individual railways in handling coal from railway cars to locomotive tender has a material bearing on the grade or size of coal which can be used. The modern railway coaling station is equipped with shaker screens, crushers and adequate bins or pockets to store the various kinds and sizes of coal required on different types of locomotives. A stoker coal is furnished to stoker-fired locomotives and egg, stove or resultant sized coal delivered to hand-fired passenger, freight or yard locomotives. If the coal station has only one pocket, which only too frequently is the case, the purchasing agent is forced to buy a coal that can be used on both stoker- and hand-fired locomotives. This results in increased consumption of fuel.

Another important factor is the question of coal segregation in passing through the coaling-station bin. Regardless of the attention given to the preparation at the mine, if provision is not made to prevent segregation in the coaling station trouble will be encountered, even stoker coal segregates into various sizes and as a result one locomotive tender is supplied with a super clean nut or pea size and the next one receives practically all "bug dust."

Inasmuch as the geographic economic considerations make it necessary for railroads that do not originate coal to draw their supply from widely separated coal fields, coal handling facilities, type and design of locomotives, etc., govern the grades and sizes of coal that can be used. Any discussion of coal selection and utilization cannot proceed, except in the most general terms, unless the controlling factors governing an individual railroad are known.

The importance of placing one grade of coal in the various coaling stations along the route of a single locomotive run cannot be over emphasized as some firemen, especially on stoker-fired locomotives, in going from one type of coal to another will experience some difficulty in properly regulating the jets and stoker speed.

Consideration should also be given the matter of unloading coal currently and not allowing it to deteriorate for months under the summer sun and rain merely because it is more convenient for yard forces to spot the coal that was last received from the mine.

The proper loading of cars is also essential. An overloaded car results in a direct loss of fuel.

Pilferage must also be considered here. While it may be practically impossible to stop all thievery, much can be accomplished by not placing cars near public road crossings, driveways and other spots that are accessible to the public. Police protection around the coal chutes, coaling tracks and yards is practical because in many instances such protection is already being provided in the vicinity for other purposes. At some points it has been found advantageous and economical to provide police protection solely for the company coal.

With the rapidly increasing number of stoker-fired locomotives it will be beneficial to purchase a size of coal that will not have to be crushed. Most types of stoker-fired coal conveying equipment crush the coal to a minus 2½ in size. Consequently, when larger coal is supplied to the tender of a stoker-fired locomotive, extra power is required to reduce the size so that it can be conveyed through to the firing table. This, in turn, results in a heavier percentage of fines, increased fuel consumption and a higher machinery maintenance expense.

The unloading of cars at the various points should be checked closely to see that all the coal is unloaded before the cars are moved away from the unloading spot. The cinder pit and ash pit accumulation should be observed closely as they are good barometers of what is happening on the road or in the boiler room.

The reclamation of the carbonaceous or combustible material that is found in the cinders and ashes prior to being loaded out as refuse for disposal should be given serious thought and consideration especially with those roads which do not originate coal on their own line. There are several types of mechanical separators used for reclaiming loose combustible substances for use in generating steam in several European countries. These separators are known as "pan ash separators" and are of the wet-jig, trough and upward-current types. These Pan Ash Separators are easy and cheap to operate and have proved their worth over several years of operation in European countries.

Since the advent of extended locomotive runs some of the through run locomotives are coupled to tenders that have a limited coal carrying capacity. This means that these tenders must be coaled to their extreme loading limits at certain coaling stations along the line in order to assure the crew an adequate supply of coal to haul the train to the next scheduled coaling stop. The result of such a practice is overloaded tenders which means loss of coal. Some other operations are supplied with tenders that have too large a coal capacity. Consequently, the coal in the back of the tenders remains there from one shop or roundhouse tender cleaning period to another. This results in deteriorated coal which means a loss of heat. Loading or coaling tenders to their maximum capacity when it is not necessary should be stopped as this practice is a deliberate waste.

The report was signed by S. A. Dickson, (chairman), supervisor fuel, Alton; H. J. Brielmaier, supervisor fuel inspection, Wabash; P. E. Buettell, fuel supervisor, C. M. St. P. & P.; R. W. Butler, fuel inspector, C. & O.; L. J. Joffray, chief fuel inspector, Illinois Central; W. A.

Larick, supervisor fuel, N. Y. C.; Hugo B. Lee, Jr., The Maumee Collieries Co.; A. F. McElhenie, The Pittsburgh & Midway Coal Mining Company; R. H. Morris, The Gauley Mountain Coal Company; Geo. G. Ritchie, fuel service engineer, C. & O.; W. L. Sheppard, Pittsburgh Coal Company, and W. J. Tapp, fuel supervisor, D. & R. G. W.

## How Can the Members Help the Association?

E. L. Woodward, western editor, *Railway Mechanical Engineer,* presented a paper on the subject "What Each Member Can Do To Promote the Effectiveness of the Railway Fuel and Traveling Engineers' Association." His paper was based on suggestions received in letters from 22 members. Those most frequently mentioned which Mr. Woodward placed at the top of the list are as follows: (1) Members should study advance copies of all committee reports and papers so that they will be able to discuss them intelligently; (2) each member should attend every meeting and support the work of the association by paying his dues in advance; (3) members should make it a definite responsibility to sell the association to the higher officers on their railroads, and (4) members should accept assignments to committees and should help in the preparation and presentation of committee reports; the work of the committee should not all be left to the chairman.

## Car Association---Freight Car Inspection

(*Continued from page 465*)

In the foregoing recommendations particular attention is called to the necessity of making special inspection and adjustment of certain parts of cars for specified service. This does not mean that the instructions governing the inspection or repairs to any part of any car used for some other service can be overlooked, but that the parts mentioned are the most vital in affording the required protection for the class of service under consideration.

### Conditioning Cars after Loading with Hides and Fertilizers

Cleaning and deodorizing of cars contaminated by the loading and transportation of such products as hides, fertilizer and other commodities listed in A. A. R. Transportation Division Cir. T-42-A, dated October 25, 1938, has been given a great deal of thought and some progress has been made, but much remains to be done. Compliance with the regulations and instructions contained in Cir. T-42-A would, to a very large extent, preserve the better class of cars for high grade commodity loading and with a corresponding reduction in cost of cleaning and reconditioning of cars.

During the past year one northwest road, after much experimental work in developing facilities and practices, reports that they have been successful in cleaning and deodorizing box cars that were badly contaminated from hide or other contaminating commodities at only a fraction of which it would have cost to replace flooring and necessary lining. Cars were cleaned during all seasons and approximately 85 per cent of all cars cleaned were made OK for high class commodities.

When a car arrives at a station or terminal point with floors or walls in a contaminated condition, and such contamination will cause damage to subsequent loading, it is the duty of the station forces or car inspectors to card and forward such cars empty to the properly assigned and designated repair or wash cleaning tracks where these cars may be cleaned, reconditioned, and made serviceable for highest class lading. When completed, they are properly classified or commodity card applied.

For the past many years the improper use of and damage to the better classes of freight car equipment caused by the loading and transportation of contaminating commodities has reached such a volume that cooperative effort among railroads, and between railroads and shippers is necessary, not only to avoid excessive costs of reconditioning equipment for the original service for which it was provided, but also to depletion of equipment available for high class loading, as well as damage to various commodities loaded in contaminated cars. Much of this can be avoided by employing regularly assigned cars for hide service or contaminated products as well as reconditioning of misused cars through the proper cleaning procedure.

Loading of hides in first class house cars is very detrimental to the equipment, causing very offensive odors as well as damage to commodities therein loaded while in such a contaminated condition. Hides produce various forms of detrimental effects on the interior portion of the car because of the manner in which they are shipped. There are forms of bacteria, or one-celled microscopic organisms which grow and increase by the millions if in a warm or moist place. Also, hides not properly cleaned, having an accumulation of fat, produce a rancid odor caused by the formation of butyric acid. This drips or falls from the hides, lodging into the crevices of the wood. Then again, there are forms of fungi formation which are plantlike growths or moulds that form on the fur portion of the hide. This also dislodges or falls from the hide onto the floor or sides of the car. The cars are possibly warm and moist, giving it a good medium to grow in within the crevices of the wood, and will continue to grow until removed. All of this causes offensive odors inside of the car and contaminates commodities loaded therein, unless removed.

By the proper cleaning procedure as described herein, the use of proper cleaner solution, tests have proven that this solution properly used will extract all this contamination from the car with very little expense. This solution acts as a disinfectant, cleaner, and deodorizer and has practical applications.

This committee will be glad to furnish interested members with trade name and manufacturer of the chemical compound used for cleaning as above outlined.

Coal cars should, of course, be given the same attention as to condition of trucks, sills, draft gear, brakes, safety appliances, etc., as box and other cars. Doors and door operating mechanisms should be carefully inspected when cars are empty to see that these parts are in proper condition before cars are loaded. Sides, ends and bottom should be tight enough to handle the kind of coal for which furnished to destination without loss.

Stock cars, in addition to being in good running order, should be given careful inspection to see that there are no protruding bolts, nails or projections of any kind that would injure stock.

The report was signed by Chairman F. G. Moody, master car builder, N. P.; F. J. Swanson, general car department supervisor, C. M., St. P. & P.; P. J. Hogan, supervisor car inspection and maintenance, N. Y., N. H. & H.; F. M. Rezner, general car foreman, C. B. & Q.; and E. A. Sweeley, mechanical superintendent, Burlington Refrigerator Express Company.

(*The report was accepted and ordered printed.*)

**New Association Discusses Problems of**

# Locomotive Maintenance

F. B. Downey, President

J. W. Oxley
First Vice-President

J. C. Miller
Third Vice-President

**Locomotive department supervisors hear papers and talks on training supervisors, apprenticeship, heat treating, scheduling and tool selection**

OVER 100 members and guests registered at the Hotel Sherman, Chicago, for the three-day meeting of the Locomotive Maintenance Officers' Association which met for its first session on Tuesday morning, October 17. At the opening session this association met jointly with the three other mechanical groups meeting at Chicago to listen to an address on the training and coaching of supervisors by L. W. Baldwin, chief executive officer, Missouri Pacific. Mr. Baldwin's address appears elsewhere in this issue.

At the afternoon session of the first day President Downey spoke at length on the scope and purpose of the reorganized association. He reviewed the work of the former International Railway General Foremen's Association and drew attention to the fact that under the old organization the membership was drawn from a limited group, principally general foremen, in the locomotive and car departments. When the former organization temporarily suspended its meetings during the early years of the depression there was, he pointed out, a move made to co-ordinate the activities of several of the so-called minor associations which resulted in the formation of the new association under its present name, with its membership limited to railroad men interested in the problems of locomotive maintenance but expanded in scope so as to include master mechanics, shop superintendents, shop engineers, machine tool supervisors, chief locomotive inspectors and their assistants as well as general shop and enginehouse foremen. Its activities, he said, will embrace all phases of locomotive repairs.

At later sessions addresses were made by F. E. Lyford, trustee, New York, Ontario & Western, and D. S. Ellis, chief mechanical officer, Chesapeake & Ohio, and the following technical papers were presented: Roundhouse Problems Caused by Long Runs, by F. J. Fahey master mechanic, New York Central; Training of Apprentices by A. H. Williams, general supervisor of apprentice training, Canadian National; Forging and Heat Treating Locomotive Parts by L. B. Herfurth, forging supervisor, Missouri Pacific; Failures of Locomotive Parts and How to Prevent Them* by F. H. Williams, assistant test engineer, Canadian National; Scheduling Locomotive Through the Shops for Classified Repairs by F. B. Downey, assistant shop superintendent, Chesapeake & Ohio and Methods for Selecting Machinery and Tools for Locomotive Repairs by R. P. Dollard, shop engineer, Chespeake & Ohio.

### Election of Officers

At the afternoon session on the last day of the meeting, the following officers were elected for the ensuing year: President, F. B. Downey, assistant shop superintendent, Chesapeake & Ohio; first vice-president, J. C. Miller, general foreman, Nickel Plate Road; second vice-president and secretary-treasurer, J. E. Goodwin, shop superintendent, Missouri Pacific; and third vice-president, F. J. Topping, assistant master mechanic, Chesapeake & Ohio. The following members were elected to the executive committee: F. T. James, master mechanic, Delaware, Lackawanna & Western (chairman); F. W. Ekins, general foreman, Atchison, Topeka & Santa Fe; W. L. Jones, general foreman, Illinois Central. J. B. Dunlop, superintendent car shops, Canadian National and W. L. Rice, superintendent of shops, Reading, continue as members of the executive committee.

* An abstract of this paper, with illustrations, will appear in a later issue.

# The Qualities of a Good Supervisor

**By F. E. Lyford**

Trustee, New York, Ontario & Western

As a result of having spent several years as a supervisor in the mechanical department, I have often felt that the mechanical department of a railroad does not get the recognition to which it is entitled. Roughly speaking, the mechanical department is responsible for the expenditure of about 20 per cent of the gross revenue of railroad operation and I believe that there are many executives who do not recognize the tremendous effect that this expenditure has on the operation of a railroad. Executives are prone to think in terms of cars and their contents and the revenue which they bring in, overlooking the importance of the locomotive which pulls the train. This is a most important unit, and they should see that everything possible is done to provide the mechanical department with the facilities necessary to reduce transportation to its lowest possible cost by keeping equipment in the best of condition.

It seems to me that mechanical department supervisors have been somewhat at fault in the attitude they have taken. In the hurry and rush of the enginehouse or shop they are likely to concentrate on getting a job out quickly in spite of the fact that it may not be thoroughly done. Because of this fact, it is necessary many times to do a job over and this repetitive work causes a waste of labor and material that can be prevented by adequate and intelligent supervision.

"Adequate supervision is the essence of good management, and management is not merely that of the head of an organization. An executive has a right to expect certain things of his supervisors, and there are four or five of these that seem to me to be of great importance.

First, an enginehouse or shop foreman, or a superintendent of motive power, should be one of the most curious fellows in the world. He should always be asking why he should do this and why he should do that. Curiosity will save him a lot of expense and will help him if he puts it to good use. Men should be curious about the jobs that are ahead of them in order that they may be ready to step into them. Many executives and supervisors are too inclined to use the old army system of merely giving an order and not explaining what the reason is back of the order. The right men are curious about reasons and will do a better job when the reason is made clear. I had a little difficulty with a supervisor on our road recently. He was given a budget and when he overran it I called him in and asked him why he had done it. I explained to him that there was just so much revenue and that if every one ran over his budget we would all soon be out of a job. Then I showed him the company's operating figures and explained them to him. Finally, he said that this was the first time anybody had told him about the financial condition of the road, and now that he knew what the problems and difficulties were he would not overrun the budget again. From then on everything ran in good shape. I felt that he, as a supervisor, had the right to know and that he could work better if he knew what was behind all this. You will observe that your men are curious to know certain things, and if you explain matters of policy and change, you will soon realize how interested they are in their jobs.

The second matter is that of supervisors being mentally and physically alert—looking like a supervisor and acting like one. The type of foremen who is constantly running around with his pockets full of papers may look busy but it does not mean that he is accomplishing much. The alert supervisor is the man who learns very quickly the important things to watch and by asking questions concerning these certain key factors can rapidly size up any situation.

The third factor is resourcefulness. Resourcefulness is one of the most valuable assets that a mechanical supervisor can have. It is not only necessary in its application to the use of machine tools and small tools, but is just as necessary in the use of information that comes to his attention. The resourceful supervisor is always able to find just the right solution to a problem and the ability to use vital information properly is sometimes one of the easiest roads to the right solution. Statistics—vital statistics concerning the operations of the road and department—are of great value to a supervisor in running his job intelligently and he should train himself to recognize what the vital statistics are.

The fourth factor is promptness. Time is essential on every railroad and things must be done on time. Promptness should be observed in recommending new equipment, new tools and in falling in line with new methods. Be prompt about the situation that seems of utmost importance to you—do your job efficiently but be sure that you have it done on time. You should give your men the help they need to enable them to do their jobs quickly. Often this need only be a clear explanation.

The last one of the factors is the question of honesty. A lot of supervisors are not honest with themselves because they are stubborn and refuse to recognize both sides of a question. It is necessary that a supervisor have his mind wide open at all times so that he can honestly approach each and every problem that he meets. Upon honest supervision depends the lives, safety and jobs of millions of people.

In conclusion, I want to say that the railroads are probably the most important industry we have and are going to have for some time, but the mechanical forces are of utmost importance in this industry—that good equipment is fine but good men are better—you can do a lot with good men and poor equipment but not much with good equipment and poor men.

J. E. Goodwin
Fourth Vice-President

F. T. James
Secretary-Treasurer

# Proper Maintenance of Modern Locomotives

**By D. S. Ellis**

Chief Mechanical Officer, Chesapeake & Ohio

The modern locomotive is called upon to produce higher sustained horsepower over longer periods of time and at higher speeds than those formerly existing, and must be in such condition at all times to meet these exacting requirements. Above all else, it must not be the cause of delays enroute. This leads us to the question at hand—the proper maintenance of locomotives.

This problem has become somewhat complicated due to the addition of various auxiliaries. It is my honest opinion that the proper maintenance of a modern locomotive will be better accomplished if we do a little more work with our heads before we start in with our hands. In other words, first analyze the problem at hand and then set up the necessary machinery in the form of proper schedules, based on mileage or time, for doing certain work and when we do tackle the actual job of accomplishing it, do it right—go all the way, not halfway, turn it out as nearly 100 per cent right as it is humanly possible to do. Proper scheduling of repairs in advance is of utmost importance.

Co-ordination and co-operation between departments is essential in order that the assigned mileage and the highest availability possible for the modern locomotive can be accomplished.

## A Problem in Economics

Like all railroad problems, that of locomotive maintenance is one of economics, and a definite plan carried to its logical conclusion is vital. This requires the use of a definite measuring stick to determine when a locomotive should be shopped and for what purpose. This measure or barometer is usually assigned mileage, but this alone is not the whole answer for it is essential that it be supplemented by a detailed inspection of work necessary, covering the true condition of the unit before it is shopped. When the locomotive is finally placed in shop for repairs, these repairs should be made in the proper manner, performing each job by the means found best to suit the condition at hand. I would suggest at this point that it is very helpful to first study the job to be done, then the best means of accomplishing it economically, and set this up as a standard.

It is quite essential, when locomotives are shopped for repairs, that each shop supervisor consider the purpose for which the locomotive is shopped, and it should be his aim to see that all work necessary is performed to keep the locomotive in service, barring unforeseen accidents, until it has made its full cycle of mileage, and so that it does not become necessary to make major repairs at terminals between shopping periods.

For example, crown brasses and cylinder bushings which, in the judgment of the supervisor or as previously established by practice, are not in condition to make the full assigned mileage, should be renewed to eliminate the necessity of renewal between shoppings, thereby relieving the engine terminals of such major work. If the foregoing is carried out diligently, I dare say that the enginehouse job in maintaining modern locomotives will be greatly lessened and the economies to be derived therefrom innumerable.

## Thorough Inspection Important

Going back to the maintenance of modern locomotives in regular service between shopping dates I recommend careful, detailed inspection and prompt performance of all work necessary prior to dispatchment of the locomotive so that when the locomotive is dispatched, the supervisor can rest comfortably in the knowledge that the locomotive will go out on its run and make its trip without causing any delay whatever to transportation insofar as mechanical details are concerned.

As in the case of the back shop supervisor, the enginehouse supervisor should at all times do the necessary work. Of course, it is understood that before the work can be done, the defects must be found, and, in many instances, herein lies the secret about engine failures which result in such costly delays.

Carrying this thought still further and supplementing the work required by Federal Rules with those rules we know are necessary, namely—a complete, detail inspection of the locomotives each 30 days, and making the necessary repairs to keep the engine in service during the next 30 days is likewise most essential.

I would seriously recommend to you at this time, if you have not already done so, the creation of a so-called standardized monthly inspection, or No. 1 Inspection Report, and instructions pertaining thereto, for if properly carried out the performance of the work thus reported will go a long way toward reducing engine failures and ultimately major repairs. The same thing, likewise, applies to so-called quarterly and annual inspections.

What I am trying to bring out here is my former reference to co-ordination, for it is only through the co-ordinated effort of those responsible for the proper maintenance of modern locomotives, through each of the various inspection and repair operations mentioned that modern locomotives will be properly maintained.

It is also important that we, as supervisors, familiarize ourselves with, and know the condition of each unit under our direct supervision. In other words, the mechanical head of the department will know this in a general way—the master mechanic in a still more complete way so far as the number of units under his direct supervision are concerned—the general foreman—the enginehouse foreman—and the inspector, in complete detail. If all of those mentioned will study and know the condition of their individual engines, at all times, the job of maintaining the modern locomotive becomes much more simple.

Both back shop and enginehouse supervision should be thoroughly familiar with all machine tools assigned to them as well as facilities over which they have jurisdiction, in order that they may at all times so arrange and plan their work that the maximum use and benefit from each tool will be derived. This is particularly true today because of the cost of our present modern equipment.

No talk of this nature would be complete without due reference to the training of shop and enginehouse forces in such a manner that each man may perform his work in the most efficient manner possible and in accordance with the prescribed instructions of each individual railroad and it should be the duty of each of us as supervisors to so train our men.

In closing, let me compliment you on the work you are undertaking and accomplishing, extend to you every wish for the successful administration of your association and pledge my personal support of the work that you are attempting to accomplish.

# Scheduling of Locomotives for Classified Repairs

**By F. B. Downey**

Assistant Shop Superintendent, Chesapeake & Ohio

The scheduling of locomotives is not a recent development. For many years this has been a subject of considerable thought and many systems and procedures have been tried out. Some were abandoned as too complicated for practical use, others were improved and changed as conditions changed, but to date, no standard system is in vogue on the railroads. However, most shops where classified repairs are made, have some kind of a schedule system.

Most shops set a tentative date for the boiler test, wheeling and the out-shopping of locomotives. These dates are subject to change as shop conditions change, and the sequence of the out-shopping lineup changes accordingly, causing discord and confusion in the shops and a corresponding loss in money. All of us are familiar with the confusion when it is found that certain engines can not be out-shopped on the promised date, and with the time and money lost trying to pick up other engines in order to get the total required or promised for the month.

It is possible to set up a schedule whereby the expected output can be out-shopped without delay or changing the sequence of operations. The practicability of such a schedule has been demonstrated for several years in the shop over which I have supervision.

## Planning Work Six Months Ahead

A schedule of engines to be out-shopped at this particular shop is worked up monthly, six months in advance at all times. Near the middle of each month, the schedule is gone over and a new sixth month added. Occasionally, due to a wreck or accident, important engines are damaged and can not be kept out of service to take their turn in line. In such cases, the program needs to be revised and some engine removed from the line-up or set back to make room for the more important engine. If properly handled, this need not cause undue confusion.

It is my opinion, that no backshop is too small or obsolete but that a properly set-up schedule will cut the cost of repairs and increase the output, as well as secure a better class of workmanship, due to the specialization.

A well-balanced schedule is a valuable asset to a shop with its specialized jobs. The advantage of specialized mechanics working the more important jobs has long been recognized by shop managements. The wider application of this principle has been prevented by frequent fluctuations in force and most shops limit their specialized jobs to the few more important and skilled operations. They have learned from sad experience the disadvantage of having to break in green men on such jobs, consequently they continue handling most of their work by general mechanics. We do not claim that the schedule will entirely prevent lay-off or shut-down periods, but we do know a well-planned program and a systematic schedule will reduce the frequency of such events and in almost every instance minimize its force. Thus, through a well-planned program and a well-balanced force, the schedule promotes efficiency through specialization of a far greater number of jobs than could ordinarily be handled.

## How to Set Up a Schedule

How then, can a proper schedule be set up in shops where none is now in vogue? A check of the reports or repairs made to locomotives given classified repairs showing work performed, costs, man-hours and additions and betterments applied for all engines which have been overhauled over a period of several years, will set up a fairly accurate figure for the man-hours needed to give the classified repairs to any particular type of locomotive. A check of the same kind will reveal the number of man-hours available for classified repairs. Thus, if there were 25 locomotives of different types to be overhauled in a month of 25 working days and the total man hours required to out-shop these locomotives is 125,000, it would require 625 men per day. If 625 men were available daily for classified repairs, the management would know that there would be no need to increase the force to get the scheduled output.

However, it is necessary to go farther than this. A check of the same kind in each craft is necessary to determine how many machinist-, boilermaker-, blacksmith-, pipefitter-, carmen-, electrician- and painter-hours are needed for this output and then the force can be properly balanced by seeing that each department has its proper quota of men. In making the check to determine the number of men required, the more engines used of each class to arrive at an average, the closer will be your figures. On one engine using the average figure, due to extra work or lack of average work it may be found that you have too many or not enough men, but where a large number of engines are involved, the total will be surprisingly close.

Where only one type of locomotive is being repaired and all receiving the same class of work, and the same repairs to each part, a permanent schedule could be set up that would remain in effect and would only be changed as the efficiency of the shop changed, due to new practices, or new machines, and devices secured.

In most shops, numerous types of locomotives are repaired and in our shop, last year, we turned out a total of 115 locomotives for classified repairs, consisting of 21 different types and the following class of repair: 31 class 2; 50 class 3 and 24 class 4. This required close scheduling and the result was a steady flow of work to the various departments, which resulted in the locomotives being out-shopped on promised dates.

The advantages of a proper schedule are that each supervisor knows at all times, just what work is in his department, the sequence in which it is to be worked, just when it is to be completed, the number of man hours necessary to complete and the man hours available for completing same.

The outstanding feature of a schedule is that after the schedule is set up and working, a close check can be made of each gang or department, and only a sufficient number of men need be provided to maintain the schedule with no slack and no man-hours wasted.

In our shop, I conducted such a check, spending sufficient time in each gang to determine that the method of handling each job was the best that circumstances and equipment permitted, that the tools and machinery were in good shape, and that the gang or department was properly supervised. I was able by this check to remove men from several gangs or departments and use them on work which increased the output, reduced expense and greatly improved the general conditions.

### Advance Material Preparations

Of important consideration with any schedule system is advance material provisions. Every shop has some system of getting material on the job, some more elaborate than others, varying from the small point that depends entirely on the stores department supplying them the moment their need arises to the more complete system of material notices given 60 to 90 days in advance of the expected shopping dates. No shop of any size can depend on the former method. Certainly a schedule could not be run on that basis. It is absolutely necessary, not only that the work be planned in advance, but the material needs be anticipated and the supply department advised in time to have the major items of material on hand when the engine is shopped.

In setting up a schedule of locomotives, the scheduling officer must be competent and know that his schedule is correct and can be completed on time. Nothing is more discouraging to the gang leader, as well as the men, than to know that the schedule is impossible and that the scheduling officer has set it up with a view of trying only to get a maximum of work out of the men and was aware that the schedule would not be met. Therefore, a schedule should be set up that is possible to be met and which at the same time, provides no slack time and will require constant and diligent effort to be made.

### Records Are Important

Another item of even greater importance is a proper record system. The shop facilities on every railroad were designed to meet their individual needs and capable of restoring equipment of such class and amount as is required of the motive power department. In spite of well-laid plans of shop engineers, lack of far-sighted planning on the part of the mechanical department or unavoidable and unforeseen emergencies sometimes make it necessary to throw peak loads on the back shops. Such a situation is often the deciding factor in the purchase of some particular item of new and modern equipment but usually this is a delayed or insufficient remedy and the immediate question "What will it take to do the job?" must be answered, "So many additional man hours." The wide difference in answers under so nearly similar circumstances have often been the source of much embarrassment. The only escape from such an undesirable position is a systematic and complete record of past performance. This record should be kept on all engines that pass through the shop for repairs and should be grouped by classes of engines and class repairs.

The following is a list of the more essential items that should be kept in this record:

(1) Engine number, class repairs, date in, date out and days in shop.
(2) Cost of labor, cost of material and total cost.
(3) Shop record of man hours used by gangs and in total.
(4) Time keeping departments record of total man hours charged. (This provides a check on the accounting and will check any big mistakes on final cost figures.)
(5) Major items of work performed. (Such as flues and lagging removed; axles, cylinders, tires, crank pins, staybolts, large firebox and boiler sheets renewed or extensively repaired.)
(6) Addition and betterment charges.
(7) Totals and averages by classes at the end of every calendar year.

This may seem like too elaborate a record, but when you consider that there is no item here but that is kept somewhere in your record system in some manner and that it really only amounts to grouping the information for ready reference, you can appreciate the advantages will far exceed the bother of recapitulating your present scattered data.

After this record is set up your guess work is over. It then becomes a matter of accurate calculation in which the factor of error is surprisingly low. If for any reason the management wants to start a different type of program work, such as additional firebox installation, new tank construction or simply change over from an average run of engines to a concentration of Mallet, Mikado or some particular type of engine or class of repairs, you can tell them immediately whether it can be done or not and if not, why.

With a little experience in dealing with this system of estimating, the management will recognize its dependability and appreciate the results. You too will appreciate it as a valuable asset in checking weak spots in your organization often before anyone else is aware of its existence. It is very necessary that this background of collateral information be established in order to insure the proper functioning of the schedule system.

### Supervision of the Schedule System

The actual schedule supervision can and should be done by one man, thoroughly familiar with the details of shop practice and procedure. With a satisfactory program which gives him the inshop and outshop dates, he plans every intermediate operation, plotting the work for the entire shop on a master sheet, which when finished shows the completion date of every job of sufficient importance to appear on the schedule. Approximately 125 items should provide sufficient detail. The advantage of additional items would be completely offset if it should require another man to help handle them, for the setting up of a schedule is a one-man job. One man must be able to take the program and look down through the days that it covers and visualize the whole job with its various operations interlocking with the precision of an intricate machine. Then he can lay it out on the master sheet just as the mechanical engineer plans the machine.

After the work is thoroughly planned and laid out on the master sheet, sections of this sheet, in miniature, containing all the items pertaining to each foreman's work are furnished to him. In addition to this, a shop line-up on a mimeographed form showing the due dates on 14 most important items, including engine numbers, date in, date out and class of repairs is furnished everyone interested, including mechanics on special jobs.

A check is made each day of jobs due and not done. These are posted in red ink on the master sheet and a delay report made and copies furnished the general supervisors and to each foreman to whom a delay was charged. This report is made every morning before nine o'clock which gives the supervisors time to investigate the delays and lend the necessary assistance where needed in time to prevent delaying the shop output.

This is a description of the routing procedure. In case of emergency, such as a wrecked engine or boiler defects showing up, the schedule proves of great assistance. Immediately after the need for a revision in the line-up occurs, the schedule is revised and new data furnished everyone concerned. It is evident that the fewer changes made, the smoother and more efficient will be the functioning of the shop generally; thus, the necessity for a well-planned program and a well-balanced force is obvious.

Workmen in the shop quickly grasp the working of such a plan and in most cases, prefer to work to such a plan, rather than to come into the shop not knowing what is scheduled for the day or when they will be asked to drop the job on which they are working and rush some other job in order to make up for a supervisor's mistake.

### Support of Shop Organization Necessary

To successfully work a schedule such as outlined, it is necessary that the entire organization be sold on the idea and give their support. If one department fails to hold up its end or shows any lack of interest, the plan will fail, confusion will occur and the output will be delayed.

The human element enters largely in this plan and there is at times a desire by some to mark off jobs as being completed when there is still a few hours work necessary to complete them. This can not be tolerated and the shop management must insist that jobs not 100 per cent completed at the dead line be shown as such on the delay report. The delay reports or red mark sheet, as it is called, is a valuable aid to the shop superintendent, master mechanic and general foreman, and should be closely followed by them. In the gangs where delays exist, investigations should immediately be made from the following angles: To see if the gang or department is properly equipped with tools to handle the work; whether there are sufficient men; whether the delay is being caused by some other department; whether the supervision is handling the job in the best manner.

Gangs where no delays exists, should be investigated with the idea of finding out where extra man-hours or slack exists. In such case, some of the overflow from other gangs can be assigned, or possibly a man removed for other work. Where it is found that this particular gang or gangs are keeping abreast of the schedule by the close attention and diligence of the men and by first-class supervision, then is the time to pour on a little of the oil of approval. It is natural to expect and appreciate praise for a job well done.

This schedule system as now being used is not complicated and will be readily understood by any competent shop supervisor. Again to summarize, it consists of: A record of the man hours and costs on all classes of repairs to locomotives on the road; a record of the average man hours and cost of each class of repair to each type of locomotives, which guides the scheduling officer in getting the schedule for a similar repair to a similar locomotive; a daily record of the man-hours on each locomotive and a record of the total of man-hours on all engines undergoing repairs; a master sheet on which the scheduling man sets the date that each part or parts are due to be ready to apply and dates they are due to be applied; a separate schedule sheet, which goes to each gang foreman and contains only the items for which he is responsible and a red mark or delay sheet which shows jobs or parts not completed on time and the party or department responsible for the delay.

I feel that a committee from this association should be appointed to make a study of this and all other systems now in use, and set up for the benefit of others an approved shopping and scheduling system, which would help those that have none and improve those now in use.

## Forgings and Their Heat Treatment

**By L. B. Herfurth**

Forging Supervisor, Missouri Pacific

It is estimated that the railroads consume about 20 per cent of the steel produced and that some three million tons of steel will be forged to its final form and size in railroad forge shops, during the year 1939. These figures indicate the importance of forging and heat-treating operations to the railroads.

The controlling factors entering into the production of quality forgings are, heating the steel to the forging temperature, the manipulation of the metal during the forging operation and the final heat treatment.

The initial heating of the steel is one of the most important steps in the production of quality forgings. Many failures of forgings have resulted from indifferent and improper heating.

The energy created by heat, brings about more physical changes in metals than any other known form of energy. When heat is applied to steel it expands, loses in strength, changes in color, undergoes structural changes, becomes more or less plastic, and at sufficiently high temperatures, changes from a solid to a liquid.

Rapid heating causes uneven expansion which results in the setting up of stresses that often cause internal segregation or bursts. Non-uniform heating will bring about the same defects. Over-heating, or burning, results in coarse structures which are practically impossible to correct by heat treatment. Over-heated steel will always be brittle and quite susceptible to early fatigue failure.

Most every one engaged in the heat treatment of steel recognizes the fact that if desirable results are to be obtained the steel must be heated slowly and uniformly to the desired temperature. Too often, slow and uniform heating is interpreted to mean a rate of heating consistent with production demands. This holds true especially when heating the steel for forging operations. There has been a tendency to divorce the heating for forging from other heat treating operations. The facts in the case are, "The heat treatment of steel starts with the initial heating for forging and ends with the heating and cooling of the final heat treating operation." With these facts in mind, it can readily be recognized that the control of the initial heating for forging is just as essential as the control of the heating for heat treatment.

In practically all forge shops, the skill and judgment of the heater is relied upon to properly heat the steel for forging operations. The temperature of the metal is, in most cases, judged by its color. The time consumed for heating is regulated by the capacity of the heating equipment and the time required for the blacksmith to work the heats. Under these conditions, it is not uncommon to see a billet drawn from the furnace which is over-heated on the surface and yet, when the billet is worked under the hammer the flow of the metal indicates that the center of the billet is considerably colder than the surface.

### How Does Steel Heat?

To realize the full benefit of the mechanical treatment, the steel must be heated to a uniform temperature throughout its cross section. The problem is not "how fast can steel be heated," but rather, "at what rate should it be heated in order to have uniformity of temperature through the mass." This brings up the question, in what manner does steel heat? The surface of the billet absorbs heat from the hot furnace gasses and receives heat by radiation from the furnace walls. The only way that the center of the billet can get heat is by conduction from the surface. When the rate of heat ap-

plication is greater than the rate of conduction, the surface will become much hotter than the center. It is practically impossible to apply heat continuously to the surface and heat a billet uniformly. At different intervals in the heating stage, the rate of heat application should be slowed up, so that heat can diffuse to the center and equalize the temperature of the billet.

The ideal conditions under which to heat steel billets for forging operations, are to pre-heat slowly to about 1,000 deg. F., and hold at this temperature for a time sufficient to permit temperature equalization throughout the mass. Then raise the temperature gradually to 1,550 to 1,600 and soak again for temperature equalization. The final step in the heating is to heat the steel to the forging temperature at a rate sufficiently slow so to maintain uniformity of temperature throughout the section being heated.

It is difficult to set a time required for the proper heating of steel, however, the old rule of allowing one hour of heating time for each inch of diameter or thickness is not far amiss when heating large billets. The type of steel being heated, the design of the furnace and the amount of work to be done on the billet are factors which govern the heating time and the forging temperature.

Small sections can be heated at a faster rate than large ones and soft ductile steels may be heated more rapidly than the higher carbon or alloy steels. For example, the ends of one in. rounds of S. A. E. 3130 steel are heated in 12 minutes to 2,000 deg. for forging the heads of unit bolts. No failures have resulted from this rapid heating. However, it is a certainty that if larger sections of this steel were heated at this rapid rate, failures would result. In another instance an attempt was made to shorten the heating time of S. A. E. 9260 steel for forming into spring plates. The section size of the plates was 5 in. x 7 in. x 16 in. The rule is to allow five minutes heating time for each $\frac{1}{16}$ in. of thickness, or 35 minutes for a plate $\frac{7}{16}$ in. thick. The heating time was shortened to 25 minutes. After heat treatment, the hardness varied in the same plate, the plates warped more than usual and the assembled springs varied in load-carrying capacity. A check of the cause of this variation revealed that the fast non-uniform heating, for forming, resulted in stresses and a non-uniform structure which would have to be corrected by a normalizing treatment prior to heating for hardening.

### Shaping the Metal

The shaping of the metal, under a hammer or press or in a forging machine die, is an operation that warrants careful consideration. The first requisite of this operation is that the forging equipment have sufficient force to penetrate to the center of the billet and work the metal in that section as well as the surface areas. Light blows or light forging equipment, works and flows the surface metal only. This causes the surface metal to creep from the center and results in segregation or a pipe in the center of the forging. This same condition also brings about non-uniformity of the grain structure due to the center of the billet not having received the proper mechanical treatment.

The forging should be shaped so that the flow lines will follow the contour of the forging. It is quite commonly known that steel is stronger in the direction of the flow lines than in transverse directions. This is exemplified by the fact that gears, having forged teeth, show greater strength and endurance than those which are machined from blanks.

The automatic shape cutting machine has been a valuable contribution to the forge shops. With the proper preparatory forging it is quite possible to produce intricate shaped forgings at a comparatively low cost. The blacksmith foreman is often tempted to eliminate the forging of the steel to the approximate shape, and cut the parts from plates, disregarding the direction of the flow lines in the metal. This practice is satisfactory for a large number of parts, but when the forging is to be subjected to impact or alternating stresses it is essential that the proper forging practices be followed.

In all probability the upset method of forging is more indifferently performed than any other method. Quite often too much metal is upset at one operation. This results in lap-overs which are a serious defect in a forging.

In other cases, the stock is doubled back and the steel is heated to the welding temperature for welding and forging in the die. This method is considered a poor practice because only one blow is required to shape the forging which is not sufficient to properly refine the grain structure. Numerous blows are more effective in refining the metal and completing the weld, than one of great force.

The design of upsetting dies should provide sufficient preliminary upsets to insure that no lap-overs, or other defects, will result in the final upset.

When high forging temperatures are employed and the forging is finished at a comparatively high temperature, the grain structure will be coarse and difficult to correct by heat treatment. On the other hand, if the forging operation is continued after the temperature of the steel has dropped to certain limits, severe stresses and internal defects are quite likely to result.

From the above it is quite evident that there is a definite range of temperature at which steel is forgable. This forging temperature range will vary with the composition of the steel. A safe maximum temperature, for the ordinary grades of forging steels is 2,100 to 2,200 deg. F. The minimum temperature, at which these steels should be forged, is 1,550 to 1,600 deg. F.

The finished non-heat-treated forging will be more or less strained, the grain structure of the steel will be distorted and elongated in the direction of the flow of the metal. Steel in this strained and unstable state is quite brittle and offers feeble resistance to fatigue. To correct this condition, the forging is subjected to some form of heat treatment.

### Why Forgings Are Heat Treated

The object of heat treatment is to relieve forging strains, induce machinability, refine the grain structure and develop the properties suitable to the service conditions under which the forging is to work.

The heat treatment of metals is made possible by the structural and physical changes that metals undergo when heated to certain temperatures. The temperatures at which these changes take place are called the critical temperatures of the metal. These changes do not occur instantaneously but require time to proceed to a completion. Furthermore, the critical temperatures will vary with the composition of the steel, and, likewise some steels will have more than one critical temperature. In such a case the completion of the structural change requires that the steel be heated through a range of temperatures.

The structure existing prior to heating to temperatures above the critical range, is obliterated and a new grain structure is born. When the steel cools, from a temperature above the critical, the reverse of these changes takes place.

Broadly speaking, the heat treatment of steel is a function of temperature and time. The steel must first be properly heated to a predetermined temperature; second, it must be held at this temperature for a period of

time to permit the completion of the structural change and to establish a state of equilibrium.

Steel can exist in four different states at atmospheric temperatures. First, the natural state as it comes from the forge shop or rolling mill; second, the annealed condition; third, the fully hardened state, and fourth, the tempered or semi-hardened state.

In the first state, as forged or the natural condition, the steel will be strained, as a result of forging operations. The grain structure will be distorted and elongated in the direction of the rolling of forging. Under these conditions the steel will be more or less brittle and have feeble resistance to shock or impact. To condition the forging to meet service requirements, it must be subjected to heat treatment by one of the several processes.

### Heat Treating Processes

There are four principal heat treating processes; namely, annealing, normalizing, hardening and tempering.

The full annealing operation consists of heating the steel slowly and uniformly, to a temperature some 50 deg. above the critical range and holding at this temperature for the proper saturation time. Following the heating and saturation cycle, the steel is cooled slowly, most always in the furnace.

The object of annealing is to soften the steel, increase machinability, relieve forging strains, refine the grain structure and develop maximum ductility. Steel in the annealed state is in its normal and weakest condition. It will have its minimum tensile and yield strength and its maximum ductility.

Normalizing is accomplished by heating the steel to a temperature from 75 to 100 deg. above the critical range, holding it at this temperature for a period of time, and cooling in still air. This treatment differs from annealing, principally as to the manner of cooling. In annealing the cooling is retarded to permit the steel to return to its normal state. When normalizing the cooling is accelerated. This faster cooling rate results in a finer grain structure, an increase in hardness and strength with a slight decrease in ductility.

Normalizing is quite effective in relieving forging strains and equalizing the structure, hence, it is very helpful in reducing warpage during machining and subsequent heat treating operations.

When large forgings are to be used in the normalized state, a tempering treatment follows the normalizing treatment. The tempering of normalized steels increased ductility and resistance to fatigue, at a slight sacrifice in strength.

Hardening, or quenching, as it is sometimes called, involves heating the steel to a temperature of 50 deg. above the critical and cooling very rapidly from that temperature. Most steels require quenching in a coolant, such as water or oil, to develop the fully hardened state. Steel always has a tendency to return to its normal state.

In annealing, the cooling rate is slow and there is sufficient time for the structural changes to occur and establish the normal condition. When the cooling rate is accelerated, the structural changes do not have time to proceed to a completion, therefore, the cooling rate governs the structure and properties resulting from heat treatment.

The structure of hardened or quenched steels will be much finer than that of annealed or normalized steels.

In the fully hardened state the steel will have its maximum hardness and strength, but will have little or no ductility. Steel in this highly strained, hardened state is seldom fit for any commercial use. The strains resulting from the rapid cooling are relieved and the hardness modified by tempering.

Tempering, or drawing, consists of reheating hardened, or normalized steel to some predetermined temperature below the lower end of the critical range. The primary object of tempering is to induce ductility or toughness and relieve the strains set up by the rapid cooling. This is accomplished at the sacrifice of tensile and yield strength. Some heat treaters are inclined to perform the tempering operation indifferently. This operation governs the properties developed by heat treatment, that is, the properties of hardened steel can be modified, by tempering, to meet any specifications within the characteristics of that particular steel.

### Railroad Forge Shop Methods

Some of the procedures followed in the forge shops of the Missouri Pacific Railroad are briefly outlined.

Carbon vanadium steel is used for the manufacture of main and side rod forgings. The billets are moved from the storage yard to the forge shop and placed on racks beneath the doors of the billet heating furnaces. Heat, escaping from the openings around the doors, warms the billets to about 250 to 300 deg. The time of the warming up period varies from 5 to 8 hr., according to the size of the billets.

About an hour before the close of the work day, the billets are placed directly in front of the open furnace doors. Heat radiates from the furnace and preheats the billets. Just before quitting time, and after the temperature of the furnace has dropped to about 1,400 deg., the billets are charged into the furnace. They remain in the furnace and preheat by radiation of heat from the furnace walls. At 11:40 p. m. the furnace is fired. The temperature is raised slowly and at 8 a. m. the billets are at the forging temperature, 2,100 to 2,200 deg. An optical pyrometer is used to check the temperature. The heating time, not including the warming up period, is 16 hours. The furnace is an over-fired type and has four working doors.

The forging equipment consists of a 5,000-lb. steam hammer. During the forging operation, when the temperature of the billet drops to 1,600 it is reheated. Four heats are required to complete a main or intermediate rod forging.

The forgings are normalized and tempered in a car bottom over-fired type furnace, which is equipped with automatic temperature control instruments. Each forging is properly supported and raised from the hearth to permit free circulation of the hot gases.

The heating time of raising the temperature of the forging to 1,650 deg. is eight hours. The forgings are held at this temperature for eight hours and then cooled in still air, to 800 deg. or less.

The car is replaced in the furnace and the forgings are reheated to the tempering temperature, which is 1,150 to 1,200 deg. This temperature is maintained for a period of eight hours and the forgings are cooled in the furnace to 800 degrees, or less. The final cooling is in still air. This procedure has been followed since 1926. To date no failures occurring from improper heating or forging, have been reported.

S. A. E. 2115 steel is used for valve motion parts, such as eccentric rods, radius rods, combination levers, etc. This is a low carbon, medium nickel steel and is comparatively soft and ductile. The billets are not preheated but are permitted to soak in the furnace, for a reasonable length of time, before firing the furnace. During the forging operation, the workmen are watched closely to insure that this steel is not forged at temperatures below 1,550 deg. The completed forgings are given a full annealing treatment. They are heated to 1,600 to 1,625 deg. and held at this temperature for two hours. The forgings are cooled in the furnace.

Passenger car equalizers are rough forged from a low carbon steel, similar to S. A. E. 1010. The rough forgings are heated to 1,650 deg., and are cooled in the furnace to 1,100 to 1,200 deg. While at this temperature, the equalizers are cut to dimension with the automatic shape cutting machine. After cutting to shape, the equalizers are given a full annealing treatment.

### Spring Shop Practice

Locomotive and coach springs are repaired and manufactured for the system, at Sedalia, Missouri. All bad order springs are shipped to this shop, are separated according to class, and stored on lift truck skid boxes. When a sufficient quantity, not less than six, of any class is accumulated, they are moved into the shop for repairs.

The bands are removed by cutting with an acetylene torch. The broken plates are removed and all plates are inspected.

The steel, S. A. E. 9260 is sheared to length cold, but it is heated to 1,650-1,700 deg. for punching the slots in the ends of the top plates.

For forming and nibbing, the steel is heated to 1,750 deg. in an over-fired type furnace, which is equipped with automatic temperature control devices. The nibbing machine is located between the furnace and the forming machine. The nib is forged in the center of the plate and then the plate is formed, on a solid type former, to the desired contour.

After the plates are cooled to 800 deg. or less, they are heated for hardening, to 1,600 deg., in a rotary hearth type furnace. A heating time of five minutes for each $\frac{1}{16}$ in. of plate thickness is used. The speed at which the hearth travels is adjusted for different plate thickness.

At the completion of the heating time, the plate has arrived at the furnace door and it is quenched in oil, which is maintained at a temperature of 150 deg. by means of thermostat control, which actuates the cooling system. The quenching tank is equipped with a conveyor. The speed of the conveyor is regulated to allow 4 minutes for a plate to pass through the quenching tank.

Immediately after hardening the plates are tempered in an electric bell type furnace. About 1,500 lb. of steel is tempered at each charge. The temperature of the charge is raised to 950 deg. in 1 to 1½ hours time. The charge is held at this temperature for 1¾ hours.

After tempering, several plates from each charge are tested for hardness. The Brinell hardness desired is 400. It varies from 388 to 415.

The assembled springs are banded in a hydraulic banding press. The capacity of the press is 75,000 lb. Each spring is given a deflection test of twice its load deflection and gaged for free height.

Several springs from each lot, are tested, in a beam type testing machine for load carrying capacity, at the load height.

The date of the manufacture or repair of the spring and the class of the spring are stamped on the band. Each spring failure is reported and a record is kept.

The use of silico manganese steel, and control of forging and heat treating operations, have brought about a remarkable reduction in spring failures.

## Selecting Machinery and Tools for Locomotive Repairs

**By R. P. Dollard**

Shop Engineer, Chesapeake & Ohio

When repairing and maintaining locomotives innumerable units of machinery and tool equipment are required. Within this range are those used for heavy operations such as, turning, boring, grinding, milling and forging, which cost up to $50,000 a unit, and those for light, but none the less important, hand operations the cost of which is a matter of cents. An appreciation of the number and kinds of machines and tools required will, therefore, be of value when selecting equipment.

Railroad machinery and tools are generally located in one of the following classes of shops: Main shops, or shops at which the heaviest of classified locomotive repairs are performed; shops at which classified repairs are made and a large number of locomotives are maintained and despatched; engine terminals at which an occasional light locomotive classified repair is made and locomotives are maintained and dispatched, and engine terminals which only despatch locomotives.

New machinery and shop equipment will yield the greatest return on the cost in the main shop. When such a shop contains a correctly proportioned amount of machinery a new machine will be used continuously when the shop is working at full production, and if necessary it can be operated on a second and third shift.

Shops at engine terminals where light repairs are made require a complement of machinery and tools of sufficient kinds and capacities to machine and repair locomotive parts accurately, also to prevent keeping motive power equipment out of service occasionally because of the lack of machine tool or shop equipment. At these locations machine tools are rarely operated continuously and if the equipment is in condition to perform work within reasonable limits of accuracy, it will be satisfactory.

It appears, therefore, when new modern machinery or equipment is selected for purchase it should be done, as far as practicable, with the view of replacing less modern machinery installed in main or other important shops. The unit released by the new installation may be reconditioned, if necessary, and installed at a less important shop or terminal to permit the retirement of an inadequate or worn-out unit. In a number of instances this procedure resulted in maximum economy for the cost involved as well as improving the machine tool operations at more than one shop.

### What Modern Machines Will Do

When consideration is first given to the selection of new equipment, all factors which determine the kind and capacity of that proposed should be looked into. Where the output of the shop is such that sufficient locomotive parts are manufactured and repaired, one specially designed or modern machine will frequently replace two standard or obsolete machines. In the machine shop, a modern automatic screw machine for stud, bushing, bolt and thimble work will replace two small lathes; a milling machine designed for machining valve motion parts and other similar work will replace two universal milling machines; a modern boring mill, on boring, turning and facing operations, will replace two lathes;

milling machines designed for driving box and shoes and wedge work will reduce the time of these operations to less than one-half of that consumed when performed on a planer. In the forge shop, forging machines and presses will take the place of two or more forges with manual operation. Shops where metal sheets and plates are worked can reduce the time of flanging and bending operations with improved bending brakes and flanging presses to less than one-half that required by hand operations.

A study of shop conditions will indicate to what extent new equipment can be used to secure the greatest amount of production and whether it may be located to serve more than one machinery group. Where a large number of units are considered, a complete detail time study of the shop operations and layouts of existing facilities with those proposed should be made to determine if the machinery re-arrangement will be balanced to produce the desired output. An analysis of this kind will properly locate the equipment in correct sequence of operations and avoid unnecessary handling of parts. This will automatically reduce labor costs.

### Factors Involved in Estimates

When the decision is made as to the kind of equipment desired, prices for estimating purposes should be secured from reliable manufacturers and an estimate of the total installation cost made, to include material labor to install, shop expense, store expense, freight and contingencies. If the installation includes the retirement of an obsolete or worn out piece of equipment, this should be accounted for in the estimate so that the cost will be divided properly between that chargeable to capital investment and operating expense.

The justification of expenditures for machinery, tools and shop equipment is rightfully expected by railroad managements. Therefore, recommendations for expenditures covering new shop facilities should be accompanied with a "necessity and reason" statement showing the estimated savings. Unless equipment is required to meet a practice required by law, the annual savings to be effected by the installation should be greater than the fixed charges on the capital investment cost, which vary from 8 and 12 per cent.

When checking the annual savings and advantages to result from a project, the following should be taken into account:

(1) The annual labor savings to be effected in the production cost with the proposed equipment. This may involve full-time jobs, a saving in the time of labor that can be devoted to other productive work or a combination of both.

(2) Reduction in the annual cost of maintaining the proposed equipment as compared with that of equipment to be replaced.

(3) Annual reduction in locomotive maintenance effected by the proposed equipment in eliminating shipping parts to other points to be machined or repaired.

(4) The necessity of and advantages to be gained by having shop equipment which will allow important motive power to be repaired and returned to service in a minimum length of time.

(5) The improved quality of work that can be performed with new equipment that can not be satisfactorily done with worn-out or obsolete equipment.

(6) The elimination of safety hazards with modern equipment.

After it has been decided what kind and capacity of machinery or tools are necessary, consideration of special and desirable features of this equipment should be analyzed. These features should be incorporated in the specifications and the manufacturer, or possibly several manufacturers, offering satisfactory equipment should be recommended for consideration.

### Factors in Selecting Machinery

In selecting machinery and tools the more important considerations are as follows:

(1) The equipment design should incorporate the latest features desirable for the work.

(2) Machine tools should have controls and operating levers so located as to eliminate loss of time.

(3) The machine should have such rigidity as to insure operation without chatter or vibration and be designed to produce a finished part within specified limits of accuracy and at minimum machine maintenance costs.

(4) Machine tools should have sufficient power, speed and feed range to use the latest high-speed cutting tools. Also, where the nature of the work permits, the use of tools and cutters of non-ferrous alloys and cemented carbide materials should be possible.

(5) Machinery used on operations requiring the use of cutting fluids or cooling compounds should be equipped with reservoirs, and pumps of adequate capacities. Catch pans and ways for returning the fluid to the reservoir should be of sufficient and correct design to prevent a sloppy condition around the machine.

(6) Lubricating systems on machinery should be complete for the lubrication of all moving parts. Splash or forced-feed systems should be provided for encased gearing and bearings. Oil cups or protected oil holes should be provided at points otherwise lubricated.

(7) All moving machine parts should be guarded insofar as is practicable.

(8) Material handling equipment and cranes should have a tested capacity 25 per cent greater than the rated capacity or have a factor of safety of at least five for the load-carrying members.

(9) When portable equipment, electric tools, pneumatic tools and other small tools are selected, consideration should be given to the quantity of repair parts required for maintaining them. Where an existing item has proved to be the most satisfactory obtainable, the selection of a duplicate will reduce the stocked repair parts.

(10) Before selecting machinery, tools or shop equipment, it should be known that the manufacturer is reliable; willing to correct defects of workmanship and material; that he can readily furnish necessary repair parts; that he has a service staff capable of furnishing the operating data necessary to secure the best results and that he has such standing as to assure the value of any guarantee given with the equipment when purchased.

(11) The price of machine tools and shop equipment is of importance. The unit offered at the highest price may contain features in design and construction which are not necessary or especially desirable. Another unit offered at the lowest bid may not be of the required quality or meet the specifications. Therefore, the price of machinery and tools should not become a deciding factor until the requirements and desirable features of the equipment offered have been given full consideration.

### Estimated Savings Should Be Checked with the Actual

After machinery, tools and shop equipment have been provided, a check of the savings actually effected against that estimated should be made. Information developed by this check will be of value when future machinery and tools are considered and will show if methods employed in estimating are correct. One railroad made a check of 12 items recently purchased and installed at various points and the following data was developed:

| | |
|---|---|
| Total estimated cost, 12 items ..... This was divided between a capital investment charge of $34,600 and operating charge of $11,700. | $46,300 |
| Estimated annual savings ..... | $9,654 |
| Estimated return on investment, per cent ..... | 27.9 |
| Actual annual savings ..... | $12,245 |
| Actual return on investment, per cent ..... | 35.4 |

These items included a 4-in. single-head pipe threading machine, hydraulic driving spring testing machine, a 42-in. hydraulic shaper planer, a 24-in. crank shaper, a 24-in. engine lathe, a shop tractor, a platform lift truck, a triple head pipe threading machine, three 140 c. f. m. air compressors, a 4-ft. radial drill and a portable coal conveyor.

### New Uses for New Tools

When studies are made in shops and engine terminals, it is possible that many uses for recently-developed time-saving equipment and tools may be found. A list of a few of these is given below:

(1) Pneumatic impact wrenches for removing and applying flexible staybolt caps and nuts to and from bolts at various locations on locomotives.

(2) Pneumatic and electric hand grinders and polishers for finishing surfaces of locomotive parts.

(3) Electric and pneumatic hand shears for cutting odd shapes in sheet metal and fitting up jackets and cylinder casings.

(4) Gasoline and electric-driven crane trucks for removing and applying heavy parts and handling material around shops and engine terminals.

(5) Pneumatic motor-driven jacks to reduce the time required for jacking locomotives and tenders in enginehouses and shops.

(6) Jib and post cranes with hoists at locations where material handling is concentrated to reduce the labor in handling, eliminate safety hazards and to avoid a loss of time in waiting on overhead traveling cranes in shops where such cranes are in use.

(7) Pneumatic-operated equipment for applying lubricating grease to locomotives to reduce the time required with hand grease guns.

(8) Portable electric and oxy-acetylene welding and cutting equipment to facilitate repairs.

(9) Expansion reamers for bringing to size bronze and non-hardened steel bushings after the bushings are pressed into valve motion and other locomotive parts.

(10) Portable electric and pneumatic drills mounted in frames and bench grinders for light work can be provided at distant locations from the other machinery to reduce time lost in handling materials to and from existing equipment.

### Defects and Incorrect Applications

Small tool equipment selected for repairing and maintaining locomotives should be of a quality and design to efficiently perform the work intended. Incorrect and inferior small tools will often result in a waste in labor and material of greater value than the cost of tool. A few of the defects and misapplications commonly found are as follows:

(1) Taps, dies and chasers of inferior steel, incorrect hardening threads and flutes incorrectly cut; or finished with improper clearance. These result in an excess tool breakage, quickly dulling cutting edges and spoiled material due to either tearing the threads or the production of a thread having incorrect diameter and finish.

(2) Reamers and machine cutters of inferior material, incorrect hardening and incorrect grinding will result in an increased amount of power required to operate the machine and poorly finished or chattered surfaces.

(3) Forged and forming machine cutting tools of low-grade tool steel with rakes and clearances incorrectly designed and which are not correctly hardened, will increase the cost of machining.

(4) Wrenches of inadequate proportions, not properly heat-treated or made from unsuitable material will not give the desired service, cause a loss of time and possibly create a safety hazard.

(5) Grinding wheels of incorrect grades, grain size or material will result in burned or poorly finished surfaces, expensive wheel consumption and added power to drive the machine.

(6) Electric drills and pneumatic drills and hammers which are too light in capacity or too heavy for the assigned work will retard the production and increase labor costs.

(7) Chisels, sets, punches and other hand tools made of the wrong steel and not properly tempered will easily break or become dull and involve excessive cost.

(8) Inferior, worn and obsolete tools which are replaced by efficient tools at various points on the railroad should be shipped to the main shop tool room for repairs, or final disposition.

The most reliable method of securing small tools that meet the requirements is to prove the quality of the tool by a service test. Other methods are to consult manufacturers or their representatives when special needs or conditions arise and to keep posted on improved developments through trade and technical publications. The exchange of information on tools, jigs and fixtures with officers and supervisors of other railroads and industrial organizations is also of great value.

### Discussion

In discussing the various factors involved in the selection of shop equipment a speaker laid considerable stress on the value of shop supervisors visiting the shops of other roads as well as industrial plants not associated with locomotive repair work. In this way, he said, many ideas are picked up the value of which more than offsets the expense.

Another speaker said that many shop men are inclined to direct most of their attention to the large and expensive units of equipment whereas, in the field of small tools there are many devices which will return greater savings on the investment than the larger units.

Another member brought out the fact that an adequate return on the investment is not always the most important consideration in the replacement of machine tools; that there always exists the operating necessity of good tools which will do the work with the required degree of accuracy.

## Enginehouse Problems Caused by Long Runs

**By F. J. Fahey**

Master Mechanic, New York Central

When I received a request to prepare a paper for this meeting entitled "Enginehouse Problems Caused by Long Runs", my first thought was that they were mechanical in nature. I believe that the initial thoughts of most enginehouse supervisors would be the same. After considerable study I have come to the conclusion that long runs are but a series of short ones rolled into one, with less frequent inspections and minor repairs being made and that there are no mechanical problems that can be definitely attributed to them. The fact that more repair work is required per long run arrival than was the case when the runs were shorter does not, in itself, constitute a problem that can be charged to long runs. Our real problems are those of improving inspection and maintenance, with the ultimate goal of keeping unnecessary locomotive failures and other adverse conditions at a minimum.

Most railroads have formulated and issued instructions covering every phase of required inspections and repairs to be made at enginehouses at specific times which have become known as daily or periodical inspection requirements. These requirements have been based on experience and their purpose has been to keep locomotive performance at a high standard. If these instructions were followed, our problems would not be so burdensome. It is recognized that the failure to comply with instructions is not always the fault of the local enginehouse supervision and employees, nevertheless, if we can develop a better observance where they are at fault, we will make a marked improvement in locomotive performance and the elimination of adverse occurrences. The principal causes of failure to observe instructions are lack of knowledge of them and their application and a poor sense of responsibility on the part of the supervision and the rank and file. Since even a sense of responsibility can be instilled in an employee, we can obtain a better observance of instructions

through education. It follows logically that the education of employees is the principal problem with which we must contend, in order to obtain more successful operation of an enginehouse and the accompanying more satisfactory performance of locomotives on long runs.

As a general foreman is the key man in his organization, he must have or develop certain characteristics himself, in order to bring about an improvement in his organization, through education. Above all, he must be a leader and develop the cooperation of all employees under his supervision. He should know all rules and instructions governing his department and spend enough of his personal time with his supervision and other employees to know that they know and understand them. He should be able to stand criticism and adopt suggestions. He should personally investigate locomotive failures and other adverse happenings that occur under his supervision and, where they involve failure to observe instructions, he should consider his responsibilities the same way a school teacher must when an above-average number of pupils fail to pass their final examinations. He should recognize his responsibility in the training of supervision, mechanics, apprentices and other employees. He should be continually on the lookout for employees in his organization who have developed or are developing the necessary qualifications for accepting greater responsibilities and should not hesitate in pointing these men out to his superiors. If he has problems which he cannot solve or does not feel sure about, he should not feel that asking questions reduces the esteem that his superiors have for him, as they are as interested in properly educating him as he should be in educating his subordinates. He should realize that he cannot educate his organization if he tolerates the Walt Wyre type of supervisor in his organization who is always figuring that "she is good for one more trip."

### Brief Daily Meetings Desirable

A general foreman's subordinate supervision are the men who make the wheels go round for him. The responsibility for training these men rests directly on him. Since the average subordinate supervisor is usually found fairly capable, as far as his ability to handle men and his mechanical knowledge is concerned, the problems of a general foreman with respect to them are to develop the same characteristics in each of them that he should have, to teach them to see things as he sees them and to know that they receive and understand all instructions issued from time to time by himself or the management. To accomplish this he must have daily contact with his supervision. It is agreed that it is almost impossible for a general foreman to hold lengthy meetings with his subordinate supervision daily, either during working hours or otherwise. However, it is possible to hold 15 to 20-minute meetings daily with the entire supervision on each particular trick. For instance, an office get-together can be held with the day supervision shortly after the rank and file have been assigned their initial work assignment, a meeting with the middle shift supervision prior to the beginning of their work assignment and the night trick meeting can be held at the close of their working assignment. At these meetings the progress of repair work can be discussed, schedules revised, instructions issued the previous day discussed and clarified, and all adverse happenings of the previous day delved into and preventions formulated to prevent a recurrence. The subordinate supervision should be encouraged to talk freely at such meetings for the purpose of obtaining an insight into the progress that is being made in the development of their capacity and for the purpose of obtaining an answer to a problem through the exchange of viewpoints.

### Instructions Should Be Made Clear

The instilling of a proper sense of responsibility in the rank and file and the imparting of maintenance instructions to them in such a manner that they are absorbed is recognized as a difficult problem. The responsibility for so doing rests upon the shoulders of the subordinate supervision and whether or not they have the capacity for a more responsible position should depend upon what they are able to accomplish with the employees they are supervising. One thing sure is that they cannot instill a proper sense of responsibility by assuming none themselves. Still, we have an alarming number of supervisors who consider that their promotion from the ranks was the signal to lessen their sense of responsibility instead of increasing it. In the imparting of maintenance instructions to the rank and file, so there will be no likelihood of them being misunderstood, there is still nothing like giving each individual man involved or likely to be involved in a certain class of work, a copy of the instructions involved, in writing. These should be presented by the subordinate supervision to each employee individually and an acknowledgment obtained of their receipt. At the time of presenting them to the subordinate employees, the foreman should make them clearer if need be. He should point out that the failure to observe them will result in locomotive failures, which in turn drives our traffic to competitors and results in loss of work to their brother employees, will be effective at such a time. The subordinate foreman should also be required to check every repair job in the course of its progress and when completed and call their employees to task for everything done in an improper manner, in order to drive instructions home. In doing this, they should get away from well-fixed opinions, that a good mechanic always does good work and that a so-called poor mechanic will never be anything else, as no mechanic is perfect and a lot of the so-called poor mechanics only require a little corrective criticism, in the proper manner, for them to show marked improvement. The difference between a poor mechanic and a good one, in the eyes of a roundhouse foreman, is mainly in the different classes of work that can be satisfactorily performed by the individual. If only some of these so-called poor mechanics were given an opportunity to do some of the other classes of work with which they are not familiar, under competent supervision, the results will be found to be rather astounding. It is recognized that some mechanics will be lacking in intelligence and skill, but it must be admitted that there is a place even for them if we confine their work to that requiring neither characteristic.

A good many of our mechanics who lack intelligence and skill for all-around service have been inherited. They have been carried so long that we are handicapped in doing anything about their case. Their presence in our organization should teach us the lesson that when we hire off-road mechanics they should be required to show that they are capable men before the expiration of the time limit set in our agreements. We certainly should not carry them as has been the practice in the past.

### Training Programs for New Men Needed

Now that business is increasing nicely and it appears that our furloughed rosters will eventually be absorbed, it would seem that this is an opportune time to mention that something should be done in the way of training additional mechanics in the enginehouses. I believe that it is a pretty well established fact that an enginehouse trained man is better suited for roundhouse work than the majority of back-shop-trained men. At enginehouses with suitable facilities we should start training additional mechanics via the helper apprentice and regular appren-

tice routes. In so doing, a general foreman should personally draw up the schedules for the helper apprentices eliminating the experience that he has obtained as a helper and concentrating on work that they have had no experience on. The general foreman should also personally see that both regular and helper apprentices obtain the experience called for in their schedules and are not kept on one class of work for a considerable length of time over their schedule, as has been the practice in the past. It would appear that it is a waste of words thus to caution a general foreman, still it has been my experience that the average roundhouse supervision are not giving sufficient thought to the fact that the apprentices of today are likely to be their headaches of tomorrow unless their training is personally supervised and follows a well defined schedule.

### Discussion

In spite of the fact that Mr. Fahey dealt almost entirely with problems of personnel and supervision in presenting his paper on long runs, the members in attendance evidenced by their discussion that there were mechanical problems involved which might be charged against the extension of locomotive runs. One member asked the question, "What troubles of a mechanical nature are you now having with long runs that you didn't have with short runs?" From several persons came replies to the effect that major enginehouse troubles of today might be listed as hot driving boxes, broken pipes and creeping reverse gears. Remarks made from the floor indicated that the general opinion was that hot driving journals could be reduced to a minimum by first-class machine work and the exercise of the greatest care in the maintenance of axles and boxes. Roller bearings were mentioned as a means of eliminating hot journals.

#### Pipe Failures

Judging by the number of persons who took part in the discussion, it was evident that engine failures from pipe breakages are quite common. One mechanical officer expressed the opinion that pipe failures are largely due to putting up pipe work too rigidly and that the installation of flexible connections at strategic points on the locomotive had resulted in a marked reduction in failures on his road. Several other members reported that such failures had, in a large measure, been reduced by the practice of welded piping assemblies in which large sections of pipe work are fabricated without screwed connections and are removed and replaced as a unit.

#### Creeping Reverse Gears

The discussion concerning creeping reverse gears brought forth little beyond the evidence that most all roads have some trouble of this nature. One member did, however, offer a suggestion that the practice of putting up reach rods after the pipe work had been done often resulted in the necessity of making bends in the reach rod. He recommended a straight reach rod, applied before the pipe work was done.

## Apprentice Training on the Canadian National

**By A. H. Williams**

General Supervisor of Apprentice Training, Canadian National Railways

It has been the practice of the railways to train mechanics through an apprenticeship. Some railways give more attention to this work than others. In years gone by little trouble was experienced in getting trained craftsmen. The United States and Canada being new countries, many came from the British Isles and European countries to settle, and among them were many trained craftsmen. Therefore it was not necessary to give much thought to the training of apprentices. In recent years the conditions have changed. Craftsmen have ceased to come from the old lands, so that the railways in the United States and Canada must train their own craftsmen.

It is not so long ago that some people thought that a boy did not require brains to learn a trade in a railway shop. I have heard it remarked, "My boy is not getting along well in school; I intend to put him into the shop to learn a trade." Once a school-teacher asked me if we could take two boys that she had in her class into the shops. She said that they seemed to have little brains, but she thought they could learn a trade. When I was through talking with this teacher she realized better the type of boy that the railway requires for apprenticeship, and I do not think that she will ever again try to get rid of her brainless pupils by attempting to send them to the railway to learn a trade.

There never was a time when youth was better prepared from an educational standpoint than now. In the past 10 years more of the youth have remained at school for a longer time. Previously a great many left school on the completion of public school or even before that time. Jobs are not now plentiful so that a larger number remain at school rather than walk the streets, and the result is that more have a better education, which is a valuable asset when they are seeking employment. Many of the youth know that if they have a high school education their chances of getting employment are better, and they think twice before leaving school on completion of the public school course.

To fit youth into the business and industrial organizations they must be trained by these organizations. One might say that there are business courses in the schools and colleges and mechanical courses in the technical schools. We know that this is not enough as most courses cannot give sufficient training in the basic fundamentals of the business or trade. You cannot train a craftsman in six months, a year or even two years. A youth may be trained to operate a machine or perform some specific operation in the building of a machine. He is not a craftsman but a specialist in one mechanical operation.

I would like to direct my remarks more especially to the training of craftsmen for the railways. I believe that a railway should have a planned system of apprentice training. It is not necessary to have an elaborate and expensive system, but a well planned system is an asset to a railway company. In the past 10 years comparatively few apprentices have been trained by the railways. Commencing with the depression in 1929 the railways had to lay off quite a number of their craftsmen and most of the railways discontinued the training of apprentices. A few railways continued their system of apprentice training on a much reduced plan, as it was felt by the managements of these railways that it would be a

mistake to discontinue the training of apprentices altogether.

To continue a policy of not training apprentices would be a mistake and the railway company that does so may find it difficult to secured trained craftsmen for replacement, as a large number of furloughed craftsmen may not return to the service owing to their finding employment with other companies. This may be particularly true with the younger men. In the past not enough thought has been given to formulating a plan for the starting of a limited number of apprentices each year. The starting of apprentices was left to the decision of the superintendent of shops. If business was good and the shops were busy a number of apprentices would be started, usually more than could be properly trained in the shop, and often too many were brought in at one time, which often made it necessary to place them wherever they could be fitted in without much thought of the training the apprentices would get, or of what value the apprentices might be to the shop.

The officers of the Canadian National realize the importance of having a well planned system for training apprentices, so that they may have mechanics who have been trained for replacement of craftsmen in the different departments of main shops, roundhouses and repair and inspection yards. For more than 75 years apprentices have been trained on railways that are now a part of the Canadian National System.

In 1930 the management of the Canadian National decided to have a uniform policy for the training of apprentices. I shall outline to you the System of Apprentice Training on the Canadian National Railways.

## Canadian National Policy

It is the policy of the Canadian National to train its own craftsmen through a standard system of apprentice training. In order that they may be retained in service as they finish their apprenticeship, only sufficient apprentices are taken on each year to take care of the normal separation from the payroll. A survey is made of the number of craftsmen in each trade who will reach the age of 65 over a period of years, at which age they are retired. A check-up is made yearly of the number of craftsmen who have been separated from the payroll during the year on account of retirements, deaths, resignations, dismissals, or promotions to assistant foremen, foremen, or any supervisory or special positions which remove them from the craftsmen's payroll and place them on monthly salaries. The survey enables the company to determine the number of apprentices to be started in any trade to take care of the separation from the payroll due to the retirement age of 65. This, together with the yearly check-up of other separations from payroll, enables the company to start apprentices to take care of their future retirements. The ratio of one apprentice to five craftsmen is never exceeded. Apprentices are credited with two years seniority on completing apprenticeship.

## Headquarters Organization

The general supervisor of apprentice training, with headquarters at Montreal, part of the organization of the chief of motive power and car equipment through the shop methods department, is responsible for the general policy of apprentice training in both shop and class work over the system. He arranges the program for the starting of apprentices in the shops on the different regions. This program is worked out in conjunction with the general superintendents of motive power and car equipment of the various regions and must have the approval of the chief of motive power and car equipment. He consults with each general superintendent of motive power and car equipment regarding matters of policy of training on his region, and makes periodical trips of inspection over the system, holding meetings with the supervisor and examiner of each region, also with shop and class instructors, to discuss problems and suggestions to improve apprentice training in shop and class work. He also inspects the class work of each apprentice and the shop training affecting each apprentice. The general supervisor of apprentice training keeps an individual file of the training of each apprentice on the system, on which are placed quarterly shop reports, class work examination papers, reports of semi-annual increases. This not only gives a very complete history of the training of each apprentice, but also enables the general supervisor to maintain a personal contact with each apprentice on the system.

## Monthly Reports

Monthly reports are forwarded from each region to the general supervisor of apprentice training, showing the number of apprentices in the service, number taken on each month, number completing apprenticeship and the number dismissed or resigned. A weekly report shows absentees from class and the reason for their absence. A monthly report is forwarded showing the names of apprentices changed from one machine to another or to different classes of work and the time spent in each position. When an apprentice is started, copies of all forms placing him in the service, also school reports and entrance examination papers are sent to the general supervisor of apprentice training. These forms are the beginning of the apprentice's training file.

## Cost of Apprentice Training

The General Supervisor keeps a check on all costs for apprentice training, which include supervision and shop and class instruction, cost of apprentice time attending classes which are in company shop time, classroom supplies, text-books and traveling expenses. All orders for classroom supplies and text-books must be approved by the general supervisor of apprentice training.

## Annual Report

A report is prepared at the end of each year covering the training of apprentices as follows:

1—Apprentices in service: Number taken on at each shop during the year, number completing apprenticeship, number retained in the service on completion of apprenticeship, number resigned from apprenticeship on account of not being suited to the trade in which apprenticed, and the number dismissed for various reasons.
2—Shop and class training: The report shows the progress made in shop and class training, and comparative marks made by each shop in subjects taught in classes, also any improvements made during the year in class and shop training.
3—Special educational work: Showing apprentices attending University in Engineering and serving their apprenticeship. Special educational visits made by apprentices to manufacturing companies and other places of interest.
4—Safety and accident prevention: Which is stressed in the training of apprentices.
5—Promotions of ex-apprentices: To supervisory positions.
6—Sports: Entered into by apprentices at different shops.
7—Cost of apprentice training.

This report is sent to the chief of motive power and car equipment, and copies to each general superintendent of motive power and car equipment.

## Regional Organization

There is a supervisor and examiner of apprentices in each region, under the direction of the general superintendent of motive power and car equipment. He has supervision over the training of apprentices at main shops, enginehouses and car repair and running yards, in accordance with the standard regulations and instructions issued from time to time by the general supervisor of apprentice training through the general superintendent of motive power and car equipment. He consults and co-operates with the superintendents of shops and with the instructors in shop and class training, and renders assistance to the shop and class instructors in any way that they may require.

## Examinations

The supervisor and examiner, in addition to supervising apprentice training, arranges for the examination of apprentices annually, in subjects taught in the apprentice classes, namely mathematics, drawing and trade theory. All apprentices must be examined at five different periods, at least, during apprenticeship of five years, or over the 500 hours that apprentices are allowed to attend classes on company time.

He prepares examination papers and, on the completion of the examinations, marks the papers. A report is made of the results of each apprentice examined, and the papers are forwarded, together with a copy of the results, to the general supervisor of apprentice training, and a report of the results is also sent to the general superintendent of motive power and car equipment.

## Inspection of Shop and Class Training

The supervisor and examiner periodically inspects the shop training of each apprentice at main shops, enginehouses and car repair and inspection yards, and questions each apprentice so as to satisfy himself that the apprentice is getting a proper training in his particular work.

He also inspects the class work of each apprentice and questions the apprentice on the work that he has been doing in class and may question the whole class on the different subjects taught, in order to find out what progress is being made.

## Report of Supervisor and Examiner

The supervisor and examiner prepares details of apprentice training in his region, at the end of each year, for the general supervisor of apprentice training, to be embodied in the annual report.

## Organization of Shop and Class Work

The superintendent of shops is responsible for the training of apprentices in both shop and class work. Class and shop instructors are responsible to him for the training of apprentices and keep him informed regarding the progress of the apprentices. When an apprentice is not making sufficient progress in his shop or class training, the instructor reports the case to the shop superintendent. No disciplinary measures are taken to suspend an apprentice unless approved by the superintendent of the shop, and no apprentice may be dismissed from the service until the supervisor and examiner for the region has investigated the case and made a report to the general superintendent of motive power and car equipment. A copy of the report is sent to the shop superintendent and to the general supervisor of apprentice training. The general superintendent of motive power and car equipment must approve any report favoring the dismissal of an apprentice before such action is taken.

## Application for Apprenticeship

Applications for apprenticeship are made to the superintendent of shops, or through the office of the general superintendent of motive power and car equipment, in which case they must be forwarded to the superintendent of the shop in which the applicant is to be apprenticed. All arrangements for the starting of an apprentice are made through the office of the superintendent of shops.

Great care is taken in selecting suitable applicants for apprenticeship. Applicants must be between the ages of 16 to 21 years, must be in good health and have good eyesight, that is, they must be able to work without the aid of glasses, and must have good hearing. They are required to pass a physical examination by a company doctor. Applicants must have at least finished public school (a majority of the applications accepted for apprenticeship have had from one to four years in high school or technical school). Applicants who have attended technical school usually make successful apprentices as it enables them to find the particular trade for which they are suited. A report must be submitted by each applicant showing the subjects taken in the last year in school, with the marks obtained. This report must be certified by the principal of the school. Applicants must pass an educational test, equal to a high school entrance examination, in arithmetic and composition in writing a letter of not less than 80 words.

Before an application is considered, the applicant must report to the employing officer, who is the superintendent of shops, for a personal interview.

## Indenture

Apprentices entering the service are indentured to serve a five-year apprenticeship, 290 days constituting an apprenticeship year. The indenture is signed by the parent or guardian and by the employing officer for the company.

## Shop Training

At each of the main shops there is an instructor who is responsible for the shop training of the apprentices in the different trades. A course of training is mapped out for each of the 11 trades in the motive power and car shops. A brief outline follows of the training given in each of the trades.

*Machinist Trade.*—Apprentices receive a training of 12 to 16 months on different classes of lathe work; 12 to 14 months on other machines including shapers, planers, boring mills and milling machines; 12 to 15 months on different bench and floor fitting, including training in oxyacetylene and electric welding; and 12 to 15 months on general erecting fitting on locomotives. In the last year of apprenticeship a sufficient number of machinist apprentices to take care of separation from the payroll are given nine months training in enginehouse fitting. After an apprentice has completed four years of general training, and during this training has shown special adaptability for a particular part of the trade, he may be given more advanced training in that class of work.

*Boilermaker Apprentice.*—Twelve months training on work including heating rivets, assisting boilermaker, sheet iron work, tender and tank construction and repairs; 12 months on ashpans, staybolts, setting and rolling of flues; 22 months on general boiler work, including six months on laying out table, and 8 months on acetylene and electric cutting and welding. During the last year a number of boilermaker apprentices are sent to the enginehouse on boiler work.

*Blacksmith Apprentice.*—Six months operating small steam hammer and helping blacksmith; 12 months light and medium work for locomotives and cars; six months light forging machines; 12 months general medium work, including tool, motion and spring work; eight months gas and electric welding and cutting machine; 16 months on general blacksmith work, including heavy forging work.

*Pipefitter Apprentices.*—Eighteen months on locomotive pipe work, including coppersmith work and general pipe work, 12 months on small copper pipes and general pipe work on locomotives, and welding; 18 months on general pipe work on freight cars and general passenger cars; 12 months on general maintenance and enginehouse work.

*Electrical Apprentices.*—Twelve months on shop maintenance and electrical repairs; six months on locomotive and tender wiring and headlights, 24 months general car lighting, air-conditioning batteries, Diesel engine electrical work; 12 months armature winding; six months in coach yards on car lighting and air-conditioning work.

*Sheet Metal Apprentices.*—Twelve months working with sheet metal worker on passenger cars; 24 months on general bench work; nine months on locomotive sheet metal work; 18 months on general passenger car work, including air-conditioning work and welding.

*Carman Apprentices.*—Twenty-four months on general car work, wood and steel, freight car trucks, draft gears, steel underframe construction and body steel work decking and lining; six months air brakes, including triple brakes, cleaning and testing; freight and passenger car application; six months mill machines; 24 months general passenger cars, wood and steel, including bench work, outside and inside construction and finishing, and trucks. A number of carman apprentices are sent to the running yards for 10 to 12 months in the last year of apprenticeship for training in running yard repairs and car inspection.

*Painter Apprentices.*—Three months in color room and paint mixing; six months freight car painting and stencilling; nine months bench work, using brush and spray gun; 12 months painting passenger cars, exteriors and interiors; 30 months' spray painting, lettering, laying out designs, stencil cutting and general painting on all classes of passenger cars.

*Upholsterer Apprentices.*—Six months helping upholsterers and upholstering engine cab seats; 12 months' foundation work, setting springs and building up seats; 18 months' general coach seats and cutting material and machine work; 12 months on general upholstering work; 12 months on blinds, curtains, carpets, mattresses, linoleum and rubber work.

*Moulder Apprentices.*—Twelve months core making; 12 months mixing sand, light machine moulding; 12 months heavy machine moulding and light floor moulding; 24 months on general floor moulding, including mixing iron and cupola practice.

*Patternmaker Apprentices.*—General training in all branches of pattern-making, wood and metal patterns.

The above is a general outline of the shop training. At each shop there is a more detailed schedule or chart which governs the moving of apprentices through the different branches of their respective trades.

It is essential that each apprentice secure his own tools as he progresses in the different departments of his trade. It has been necessary in some cases to keep apprentices from being moved on account of their not having the necessary tools. However, with the co-operation of the shop superintendents and departmental foremen, no difficulty is experienced in apprentices securing tools.

## Safety Education

Efforts have been made to impress upon the apprentices the importance of safety. All apprentices have been supplied with copies of the company's safety rules and are examined as to their knowledge of these rules soon after entering the service. Goggles have been supplied and efforts made to see that apprentices wear clean and safe apparel.

## Reports of the Progress Made in Shop Training

When an apprentice has completed the allotted time on a machine or on other work, a report is made of his progress and marks are allowed for punctuality, initiative, discipline and ability. This report is signed by the foreman of the department in which the apprentice was working and by the shop instructor. It is sent to the shop superintendent and then to the supervisor and examiner of apprentices. A copy of this report is forwarded to the general supervisor of apprentice training. The shop instructor endeavors to keep the shop superintendent informed as to the progress the apprentice is making in his trade, as a successful apprenticeship depends greatly on the support and co-operation of the shop superintendent.

## Class Training

The apprentice class instructor is responsible for class instruction, the subjects taught being mathematics, mechanical drawing and trade theory. The company maintenance regulations governing shop practice are used in the teaching of trade theory. When an apprentice is working on any part of a locomotive or car, he must study the maintenance regulation governing that work. In addition to the maintenance regulations, text books are purchased from the International Correspondence Schools, and are selected from the different engineering and trade courses offered by that company.

We also stress the studying of the A.A.R. rules and safety appliances for carmen apprentices, acetylene welding and instructions on electric welding. Instruction books supplied by the railway supply companies on the following subjects are now used in the training of apprentices: superheaters, exhaust steam injectors, stokers, boosters, reverse gears, mechanical lubricators and headlight generators, and passenger-car lighting, heating and air conditioning. Arrangements are made with railway equipment companies to have their service men give lectures to apprentices on their equipment used on locomotives and cars. These lectures are beneficial to apprentices as they enable them to become familiar with the construction and repairs, so that when they are required to work on the equipment they can do so in a more intelligent way. Arrangements are also made with A.A.R. in-

spectors to give lectures to carman apprentices. These lectures give carman apprentices information that is of great assistance to them, especially in connection with yard inspection and running repairs. Lectures have also been given on air brakes, Diesel work, water conditioning and boiler construction.

### Apprentices Attending Class on Company's Time

Apprentices attend class two hours each week during their apprenticeship, the total number of hours being limited to 500 during an apprenticeship. Two or three classes are held each day and the number allotted to each class is from 10 to 15 apprentices. The classes are kept down to the smallest possible number to avoid taking too many apprentices from the shop at one time. The class time is apportioned to the study of mathematics, drawing and trade theory. In the study of mathematics, an apprentice is required to make a review and is then given a test examination in order to find out in what part of the book he should start to study. This is done to prevent time being spent on a subject with which the apprentice is familiar. In the subject of drawing, most of the first year is spent on geometrical drawing and projection, then on simple mechanical drawing, the apprentices making their drawings from objects. The importance of sketching is stressed; all apprentices may not become draftsmen but they are all taught to make an intelligent working sketch. In trade theory the apprentice studies the text book that applies to the work that he is doing in the shop, i.e., when on lathe work in the shop, the text book studied in class is on lathe work. By this method the apprentice gets the theory of the work, which helps him in the practical shop work.

Quite a number of the draftsmen working in the company's drafting rooms are ex-apprentices who received their first training in drawing in the apprentice classroom.

### Home Study

The railway does not believe that it is a good policy to pay an apprentice for all the time that he must spend in study. The company pays for the two hours spent in class each week, but the apprentice must spend at least two additional hours each week in home study. It is gratifying to see the interest taken in class study and the majority of apprentices spend more than two hours a week on study in their own time.

### Deductions from Apprentices' Wages

Apprentices pay $10 a year for five years during the time of apprenticeship, to cover the expense of purchasing text books. This amount is deducted from the wages of apprentices, one dollar a month for ten months each year. When an apprentice completes the study of a text book, it becomes his own property, and in this way he builds up a library of his own books on trade theory, which are very useful to him for reference.

### Refunds to Apprentices

As an incentive to study, 50 per cent of the money deducted from apprentices' wages is returned on the completion of apprenticeship to all apprentices making an average of 75 per cent or over in each of the three subjects, mathematics, mechanical drawing and trade theory.

### Apprentice Records

Records are built up of the training of each apprentice as follows: (a) a shop progress report of the movement of each apprentice in the different departments, during the whole period of apprenticeship; (b) a copy of the form giving apprentices their semi-annual increases; (c) a record of the number of hours worked during apprenticeship. Any time lost by an apprentice on his own account must be made up before he receives his next increase in rate. Time lost due to the closing down of shops is made up at the rate payable for the last period of apprenticeship; (d) a record of all examinations in class work and the marks obtained in each examination, all examination papers being filed on the apprentice's individual file.

### Individual Report of Apprentice Training

At the completion of apprenticeship, a report is made up by the supervisor and examiner of apprentices, showing the average marks made in shop training, also the average marks made in the subjects taught in class, with any special remarks about the apprentice and his training. A copy of this report is sent to the general supervisor of apprentice training and to the general superintendent of motive power and car equipment. These reports enable the company to single out the apprentices who have been outstanding throughout their apprenticeship.

When an apprentice completes his apprenticeship, he is given a certificate stating that during his apprenticeship he has received the requisite practical training and instruction necessary to qualify him to practice the said art or trade. The certificate is signed by the general supervisor of apprentice training and approved by the general superintendent of motive power and car equipment.

### Apprentices Attending Universities

Arrangements can be made to allow apprentices leave of absence to attend a university during apprenticeship. Six ex-apprentices have completed a five-year university training in engineering along with their five-year apprenticeship. All six have been placed in the mechanical and electrical department. At the present time, nine apprentices are attending a university and still taking their apprenticeship training. It is found that those who take the combined apprenticeship and university training are better qualified to be advanced to supervisory positions and, no doubt, in time will make good executives.

### Educational Visits

At different shops on the system, educational visits are made to manufacturing plants at the local points, or to other cities in Canada or the United States which may be visited by leaving on Friday and returning Sunday. Such visits are arranged by the instructor with the full co-operation of the superintendent of shops. The company provides transportation, but other expenses must be met by the apprentices. These visits have been of great value to the apprentices, increasing their knowledge and enlarging their viewpoints, and giving them experiences which otherwise might not have been possible.

### Sports

The Canadian National encourages sports among its apprentices. At some shops, the apprentices have their own clubs, run by themselves, with the superintendents of shops and supervisors as honorary members. The shop instructors act as advisory officers. These clubs arrange sports, such as baseball, basketball, bowling and hockey, and each club arranges for an annual social evening and dance. Exchange visits are arranged between shops on the region for a game of baseball or bowling, and these visits bring the apprentices of the various shops on the region together, enabling them to get acquainted with each other.

The success and practical training of an apprentice depend greatly upon the interest taken by the shop superintendent, the general foremen and the department foreman. The time that an apprentice is under the shop or class instructor is limited, but when an apprentice is in a department he is almost constantly under the foreman of that department, and much depends upon the interest of the foreman in the training that the apprentice gets in that department, in having him placed on different classes of work in the department, apart from machine work. There is sometimes a tendency, when an apprentice is working with a craftsman to have him work in the capacity of a helper. There are craftsmen who do not want to trust him with important parts of the work. I like to see the craftsman, as the saying goes, put it up to the apprentice, not afraid to give him plenty to do. When going through one of the shops and passing beside an engine one day, I heard a craftsman say to an apprentice who was working with him, "You have as much brains as I have, and you know how this job is done. Now, you go ahead and do it." That is the attitude to take with an apprentice. These apprentices are no longer boys. They are young men, and most of them well developed and not afraid of work. As long as an apprentice is not required to do heavy lifting beyond his strength, no harm will result in keeping him busy.

There are times when an apprentice should be given the responsibility of doing jobs by himself, under the direction of the foreman. This will develop his confidence. It is only natural for the apprentice to depend on the craftsman as long as he can. I think the apprentice, during the latter years of apprenticeship, should be given a helper. There may be some who will not agree with this statement, but I know there are foremen who will. I am not advocating apprentices taking the place of craftsmen until they have finished their apprenticeship, but if you are to have apprentices trained

to take their places as craftsmen on the completion of their apprenticeship, their training must be such that they will be fitted to do so. If you do not give the apprentice the type of work he will be required to do when he goes out as a craftsman, he may make costly mistakes in learning how it is done. Is it not better to give him this training while he is in his apprenticeship and under the direction of a foreman who can guide him? I believe in giving the apprentice work that is difficult enough for him to have to use his head, to do some thinking, and also something that is worth doing. I don't mean that this should be done at first, but gradually as he advances. Very few apprentices will fail you if they understand that you trust them and have confidence in their ability. An apprenticeship can be spoiled by giving work that is too simple.

### Value of Apprentice Training

Through a well-planned apprentice training system an apprentice gets a thorough training in all branches of his craft as well as a good technical training in mathematics applicable to his craft, mechanical drawing and trade theory. A good foundation is laid, upon which he may build throughout his years of experience as a craftsman.

A system of apprenticeship such as we have on the Canadian National is an asset. The railway is supplied with well-trained craftsmen and potential supervisors, who may advance to the highest offices of the mechanical department, and even to highest responsibility in the railway.

The five years that an apprentice is in training are usually between the ages of 16 and 23. This is one of the most important periods of his life, as it is in this period that a young man begins to assert himself, to act and think for himself, and to question home training and authority. Without proper guidance, it may mean disaster for him. When a young man begins an apprenticeship with the Canadian National, he is placed under the direction of men who are not only able to train him in his trade, but to give him the needed guidance and to detect in him those things which need correction. This cannot be done by driving a young fellow, but by personal contact and by winning his confidence.

I always have a feeling of regret when I have to turn away so many young men, because it is impossible to consider all who would like to be placed in the service as apprentices. I never feel that it is a waste of time to spend a few minutes talking with a young man. Although I may not be able to give him any hope of employment, yet I may be able to give him some advice, or leave a thought with him that will encourage him to go on. Is it any wonder that so many young men go wrong when they find themselves up against a stone wall, without any hope for the future? Some years ago I was on a committee to make a survey of apprentice training for the American Railway Association. When the report of the committee was submitted at a meeting of the railway association, and while it was being discussed, a railway officer got up and made this statement. "A very short time ago I was speaking to a warden of a penitentiary who said, 'very few men come to this institution who have served an apprenticeship.' Why did the warden make that statement? I think I can tell you. Statistics show that the majority of men confined in penitentiaries go there between the ages of 18 and 24 years. During those critical years, young men who have had the opportunity of serving an apprenticeship have been under training and discipline, and their minds have been well occupied with work.

The greatest asset that a country has is its youth. Youth must be educated and trained—the extent of their value, both to themselves and to their country, depends on their training. The Canadian National is making a valuable contribution to the country through its system of apprentice training. The training of mechanics through the apprentice system is twofold in its outlook. We are not only training craftsmen, but young men who are to be the citizens of our country and upon whose shoulders will rest its destiny.

Young men will copy the good that is reflected by the man with whom they come in contact, and they may also copy some things that it were better they did not. I believe that those who have anything to do with the training of apprentices should have the same interest in them as they would like other men to have in their own sons. Man is a copyist. We are the reflection of others. The only lasting monument that we can leave to posterity is what we give of ourselves, of our knowledge and of our experience, which will continue in the lives of others.

## Training and Coaching Supervisors

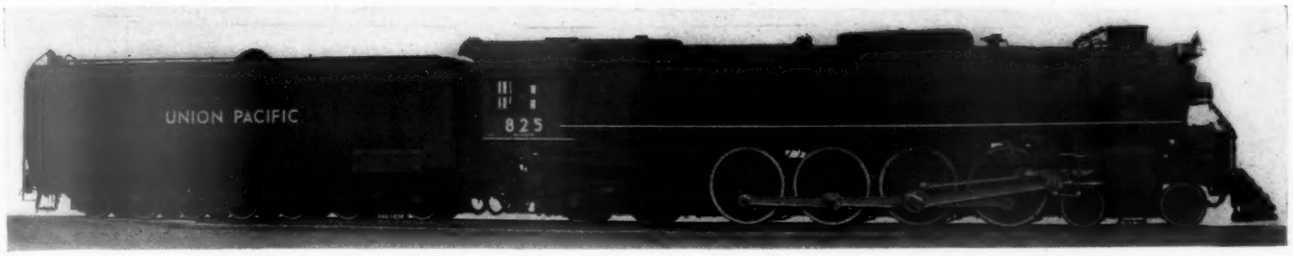
(*Continued from page 432*)

against which the railroads are suffering could and would exert a tremendous influence for good. Seeing to it that employees are properly advised and encouraged in such efforts seems to me to be a broad and important avenue for constructive coaching. Carrying on public relations campaign in the shops or, in other words, selling the railroad to all working in the shops that they may, in turn know as much of their railroad is, I realize, far afield from the old days, but we have left those behind us. We are living in a new day, a day of changes and progress and everyone must keep in step. As evidence of this one must only think back to the time before such ideas as educational training courses for apprentices was ever heard of and before training courses for supervisors had come into existence. Both have proved their value on the Missouri Pacific.

A large number of our supervisors are voluntary students in courses made possible to them; likewise apprentices. Learning from books about shop practices, about how to handle men along with work—the practical side—produces splendid results and it is not theoretical but most workable, as results have proved it helpful to the individual, to the shop and to the railroad; just as ever-increasing efficiency of America's railways has proved that we can find better ways of doing things if we but look for them. Again, co-operative working, looking through the eyes of the fellow workman—those working for them—as well as his own makes it possible for supervision to find better methods to do their work.

It is a big task, and an important one, for those in charge of the supervisors to encourage and urge continued looking to what some may call "cutting the head in"; progress has been made in this direction. It must have been if one but looks at the glorious, inspiring record of our achievement. Greater success lies ahead of us; no one who knows railroad men can doubt that.

If I have one message that I would like to leave with you today it is that you know enough about your work, about your railroad to believe in it and, in turn, sell it to your friends, to the public, and constantly insist on a fair measure of opportunity for your industry.




Passenger and fast freight locomotive built for the Union Pacific by the American Locomotive Company

**Powerful High-Speed**

# Locomotives for Union Pacific

**Fifteen 4-8-4 type built by the American Locomotive Company evolve from design of those received from the same builder in 1937—Tractive force, 63,800 lb.; driving wheels, 80 in. diameter**

DELIVERIES of 15 4-8-4 type high-speed freight-passenger locomotives have been made during the past two months to the Union Pacific by the American Locomotive Company. While based on the design of the 20 4-8-4 type which were built by the same company for this railroad in 1937, a comparison of the dimensions shows considerable change in detail. The cylinders of the new locomotives have been increased from 24½ in. to 25 in. in diameter, and the driving wheels from 77 in. to 80 in. in diameter. The same boiler pressure, 300 lb., has been retained. There has been no significant change in the tractive force—63,800 lb.

## The Boiler

The boiler is equipped with a Type E superheater. It has 184 flues, 3¾ in. in diameter, and 50 tubes 2¼ in. in diameter, 19 ft. in length. This is 18 in. shorter than the tubes and flues in the boiler equipped with the Type A superheater on the original design. That length has been added to the combustion chamber which is now 90 in. long as compared with 72 in. on the earlier locomotives. The firebox is the same width and length. The firebox tube sheet is welded to the combustion chamber and firebox crown sheet, and the firebox door sheet is welded. Flannery flexible staybolts with welded sleeves are installed around the outside of the back head, at the top, across the corners and down the ends of the side sheets. There is a complete installation in the throat and around the combustion chamber. All crown stays are also flexibles, except the eight center longitudinal rows, and flexibles are installed in these rows for the first six transverse rows across the front of the combustion chamber. The back corners of the mud ring retain the large radius.

The four-wheel tender truck

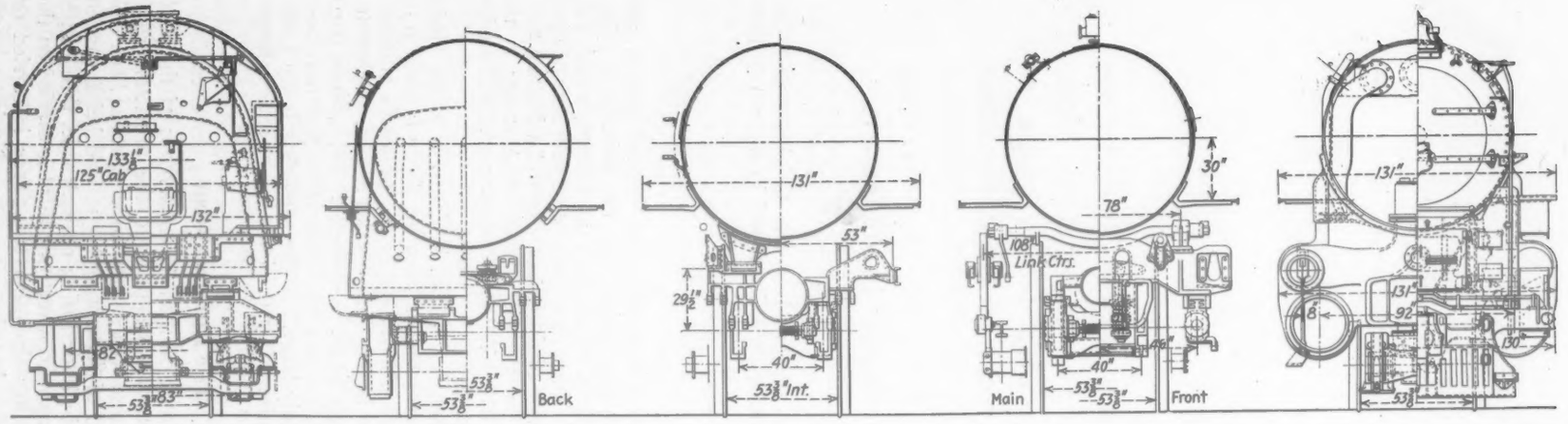
The boiler is supported on the Commonwealth bed casting by a sliding shoe, immersed in oil, which takes the place of the conventional waist sheet, and is located at the center of the boiler. In order to give added stiffness, the smokebox liner is extended upward to the center line of the boiler.

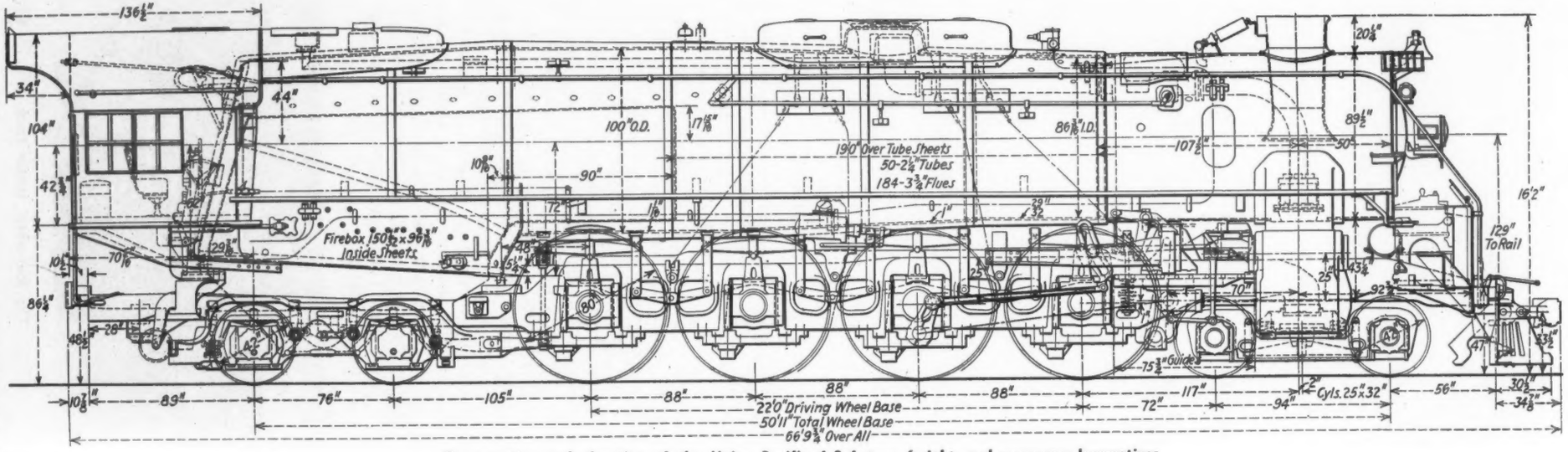
The fireboxes are fitted with Firebar grates, and Security brick arches carried on five 4-in. arch tubes. There are 12 2¼-in. combustion tubes through each side of the firebox. There is a Sellers exhaust steam injector on the left side of the locomotive and a Nathan nonlifting injector on the right side. The stoker is the Standard type BK. Wilson blow-off cocks and sludge removers are used.

The smokestack is 26½ in. in diameter at the choke and has a continuous taper from the choke to the top of the stack. The exhaust pipe is the railroad's standard multiple-jet type having four nozzles 3⅞ in. in diameter located on a circle 13 in. in diameter. All exhaust ports through the cylinder and into the exhaust pipe have been made exceptionally large. In the smokebox is the Locomotive Economizer Corporation's front-end arrangement.

## The Running Gear

The engine truck on these locomotives is of the Alco design similar to those applied to the previous order, except that an improved spring suspension has been employed. Instead of the spring-borne load being carried on a single semi-elliptic spring on each side, this load is divided. Only approximately one-third is carried on the semi-elliptic spring; the other two-thirds is carried on coil springs. This has the advantage of using a much shallower semi-elliptic spring which is therefore more flexible, but the initial shocks are absorbed by the coil springs.




Cross-section and elevation of the Union Pacific 4-8-4 type freight and passenger locomotives

**General Dimensions Weights and Proportions of the U. P. 4-8-4 Type Passenger and Fast-Freight Locomotives**

| | |
|---|---|
| Railroad | U. P. |
| Builder | Alco |
| Type of locomotive | 4-8-4 |
| Service | Passenger and fast freight |
| Dimensions: | |
| Height to top of stack, ft.-in. | 16–2 |
| Height to center of boiler, ft.-in. | 10–9 |
| Width overall, in. | 133⅛ |
| Cylinder centers, in. | 92 |
| Weights in working order, lb.: | |
| On drivers | 270,000 |
| On front truck | 94,000 |
| On trailing truck | 119,000 |
| Total engine | 483,000 |
| Tender | 406,500 |
| Wheel bases, ft.-in.: | |
| Driving | 22–0 |
| Engine, total | 50–11 |
| Engine and tender, total | 98-5 |
| Wheels, diameter outside tires, in.: | |
| Driving | 80 |
| Front truck | 42 |
| Trailing truck | 42 |
| Engine: | |
| Cylinders, number, diameter and stroke, in. | 2–25 × 32 |
| Valve gear, type | Walschaert |
| Valves, piston type, size, in. | 12 |
| Maximum travel, in. | 7 |
| Steam lap, in. | 1⅜ |
| Exhaust clearance, in. | ¼ |
| Lead, in. | 6/16 |
| Boiler: | |
| Type | Conical |
| Steam pressure, lb. per sq. in. | 300 |
| Diameter, first ring, inside, in. | 86 3/16 |
| Diameter, largest, outside, in. | 100 |
| Firebox, length, in. | 150 1/32 |
| Firebox, width, in. | 96 3/16 |
| Height mud ring to crown sheet, back, in. | 79 15/16 |
| Height mud ring to crown sheet, front, in. | 89 15/16 |
| Combusion chamber length, in. | 90 |
| Arch tubes, number and diameter, in. | 5–4 |
| Tubes, number and diameter, in. | 50–2¼ |
| Flues, number and diameter, in. | 184-3¾ |
| Length over tube sheets, ft.-in. | 19-0 |
| Net gas area through tubes and flues, sq. ft. | 9.91 |
| Fuel | Bituminous coal |
| Grate area, sq. ft. | 100.2 |
| Heating surfaces, sq. ft.: | |
| Firebox | 442 |
| Arch tubes | 57 |
| Firebox, total | 499 |
| Tubes and flues | 3,971 |
| Evaporative, total | 4,470 |
| Superheating | 1,900 |
| Combined evap. and superheat. | 6,370 |
| Tender: | |
| Style | 14-wheel |
| Water capacity, gal. | 23,500 |
| Fuel capacity, tons, level full | 25 |
| Rated tractive force, engine, 85 per cent, lb. | 63,800 |
| Weight proportions: | |
| Weight on drivers ÷ weight engine, per cent | 55.90 |
| Weight on drivers ÷ tractive force | 4.23 |
| Weight of engine ÷ evap. heat. surface | 108.05 |
| Weight of engine ÷ comb. heat, surface | 75.82 |
| Boiler Proportions: | |
| Firebox h. s. per cent comb. h. s. | 7.83 |
| Tube-flue h. s. per cent comb. h. s. | 62.34 |
| Superheat. surface per cent comb. h. s. | 29.83 |
| Firebox h. s. ÷ grate area | 4.98 |
| Tube-flue h. s. ÷ grate area | 39.63 |
| Superheat. surface ÷ grate area | 18.96 |
| Comb. h. s. ÷ grate area | 63.57 |
| Gas area, tubes-flues, per cent of grate area | 9.89 |
| Evap. htg. surface ÷ grate area | 44.61 |
| Tractive force ÷ grate area | 636.7 |
| Tractive force ÷ evap. htg. surface | 14.27 |
| Tractive force ÷ comb. h. s. | 100.2 |
| Tractive force × dia. drivers ÷ comb. h. s. | 801.3 |

The side frames of the truck are formed with pedestals in which the roller-bearing housings fit. Between the top of the roller-bearing housings and the engine-truck frames is interposed a pad of Fabreeka for the purpose of absorbing the rail vibration before it can enter the truck side frame.

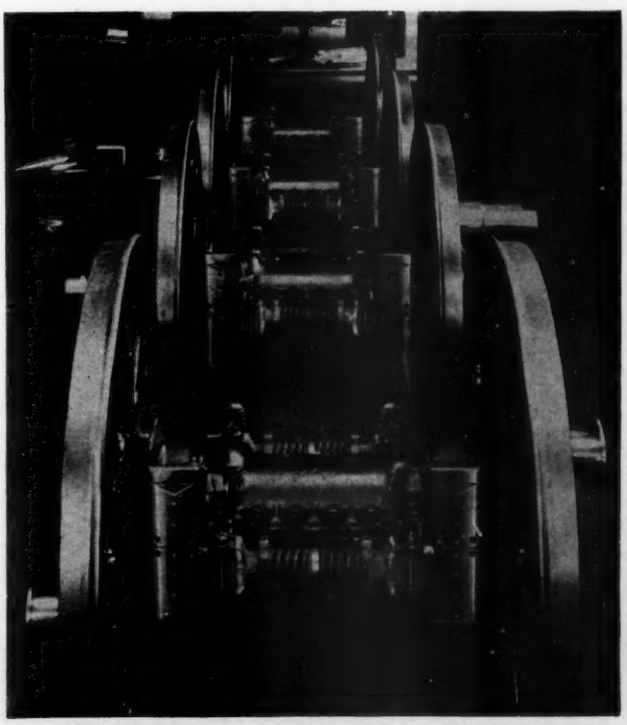
The Alco geared roller-centering device has been designed with roller surfaces machined to produce the resistance desired. The initial resistance is about 17 per cent of the spring-borne load for a distance of 1 in. each side of the center, changing at this point to 33⅓ per cent resistance and remaining at this figure throughout the range of the lateral travel.

The swing frame in which the swing bolster fits is protected front and back with hardened-steel renewable wearing plates. Mechanical force-feed lubrication is provided on these sliding surfaces as well as on the center-plate bearing.

On ten of the locomotives the engine truck, the driving axles, the trailing truck, and the tender journals are all fitted with Timken roller bearings. On the other five locomotives all of these journals have SKF roller bearings. On the engine trucks of the locomotives equipped with the SKF roller bearings, the upper half of the bearing housings extends from side to side, while the lower half is simply long enough to enclose the roller bearings. The main driving-axle journals are nominally 13¾ in. and the others 12½ in. in diameter. The diameters of the engine-truck journals are 8¼ in.; of the trailing-truck journals, 8 in., and of the tender journals, 6¾ in. The driving wheels have Boxpok centers.

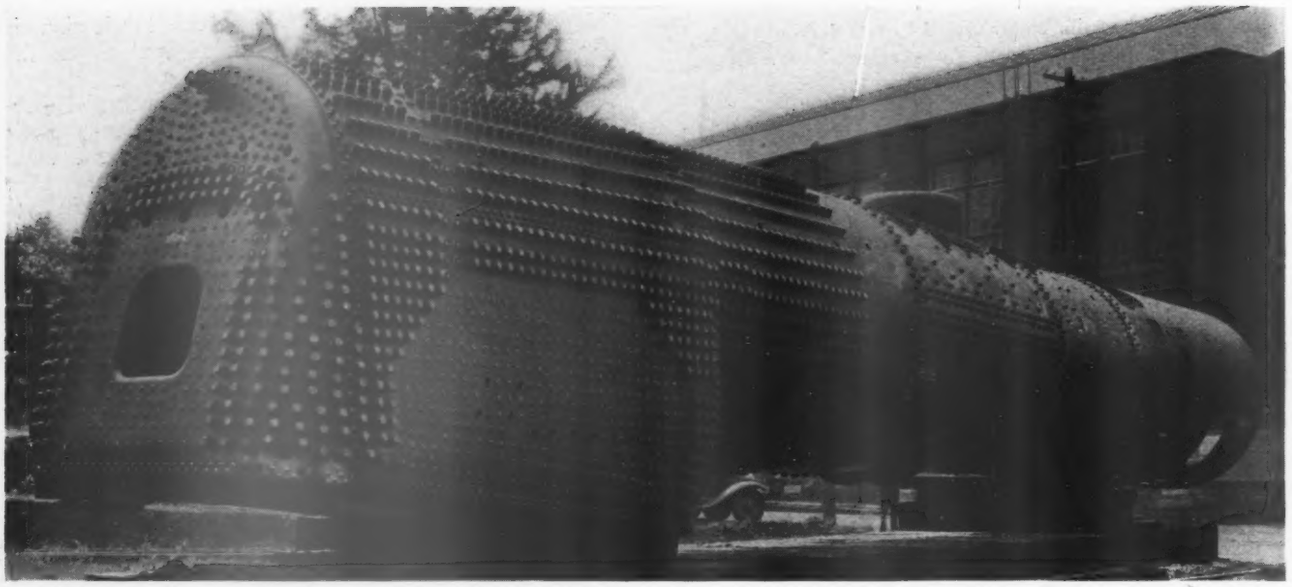
A feature of the driving-spring suspension is the use of the coil springs at the dead ends of the spring rigging. At the front end of the locomotive is a cross equalizer

**Alco engine truck with a combination of coil- and elliptic-spring suspension**



**Alco lateral-cushioning devices applied on Timken roller-bearing driving boxes**

Cross-section and elevation of the Union Pacific 4-8-4 type freight and passenger locomotives



The boiler of the Union Pacific 4-8-4 type locomotives

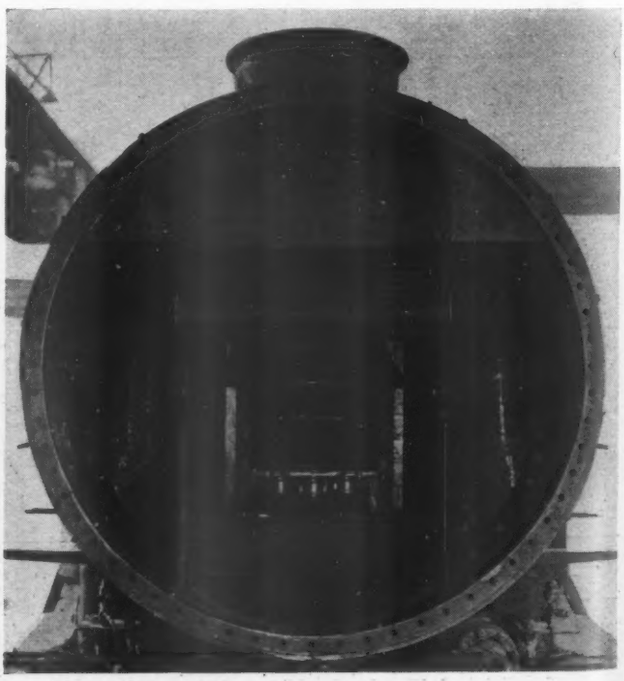
and connected to the equalizer at points inside of the frames are spring hangers which pass through coil springs seated against the underside of the bed casting.

A similar cross equalizer is applied at the rear end of the back driving springs and the hangers which connect to the front ends of the trailing-truck equalizers pass through coil springs on their upper ends which are seated in this cross equalizer. The rear trailing-truck spring-hanger is also connected through a coil spring to the trailing-truck frame. The trailing truck is the Commonwealth four-wheel delta type.

Each of the driving axles, with the exception of the rear axle, is equipped with the Alco lateral-cushioning device. On the front driving axle a lateral movement of ¾ in. each side of the center is provided, and the initial lateral resistance is approximately 17 per cent of the spring-borne load, increasing at the rate of about 2,000 lb. for each ⅛ in. of travel. The cushioning devices on the second and third driving axles furnish 5/16 in. lateral movement each side and have an initial lateral resistance 8 per cent of the spring-borne load, increasing at the same rate as for the front axle.

All truck wheels are rolled steel, 42 in. in diameter, the same size wheel being used on the engine truck, the trailing truck, and the tender. For ten of the locomotives they were furnished by the Carnegie-Illinois Steel Corporation; for the other five, they were furnished by the Bethlehem Steel Company.

The Locomotive Economizer Company's spark arrester ready for installation



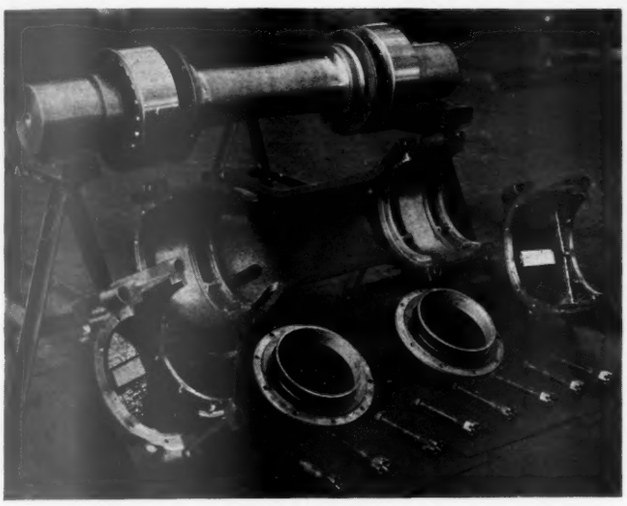
Front of the spark arrester removed to show the exhaust tips and stack extension

### Pistons and Valves

The piston heads are alloy rolled steel with the Locomotive Finished Material Company combined universal

sectional type bull rings and packing rings, half bronze and half cast iron. The piston valves are the Hunt-Spiller lightweight type with Duplex sectional packing rings. Cylinder and valve bushings are also of Hunt-Spiller gun iron.

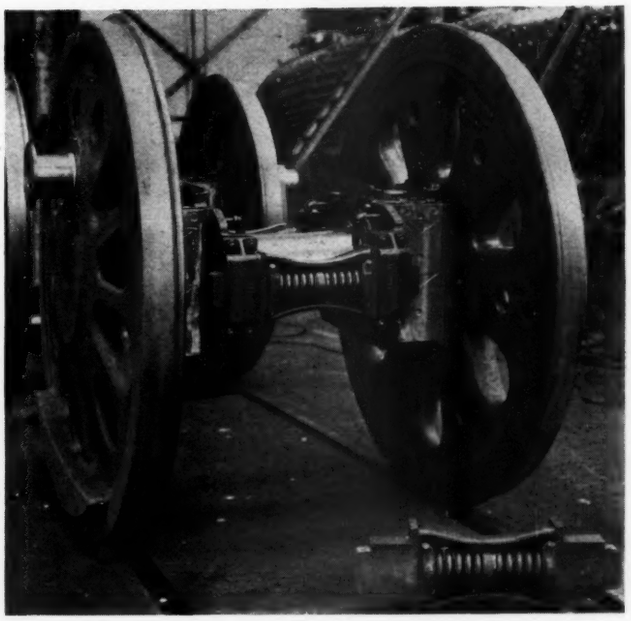
The valve motion is the Walschaert type controlled by the Franklin Type reverse gears on ten locomotives and Alco reverse gears on the other five. The maximum valve travel is 7 in. All valve-motion parts are fitted with the McGill type needle bearing, as is also the front



**Disassembled bearing housings of an engine-truck axle fitted with SKF roller bearings**

end of the eccentric rod. The back end of the eccentric rod has an SKF self-aligning type bearing.

Valve-motion parts have Alemite fittings for soft-grease lubrication. Mechanical lubrication takes care of the steam chest, cylinder barrels, stoker engine, throttle, driving-box pedestal faces, driving-box automatic



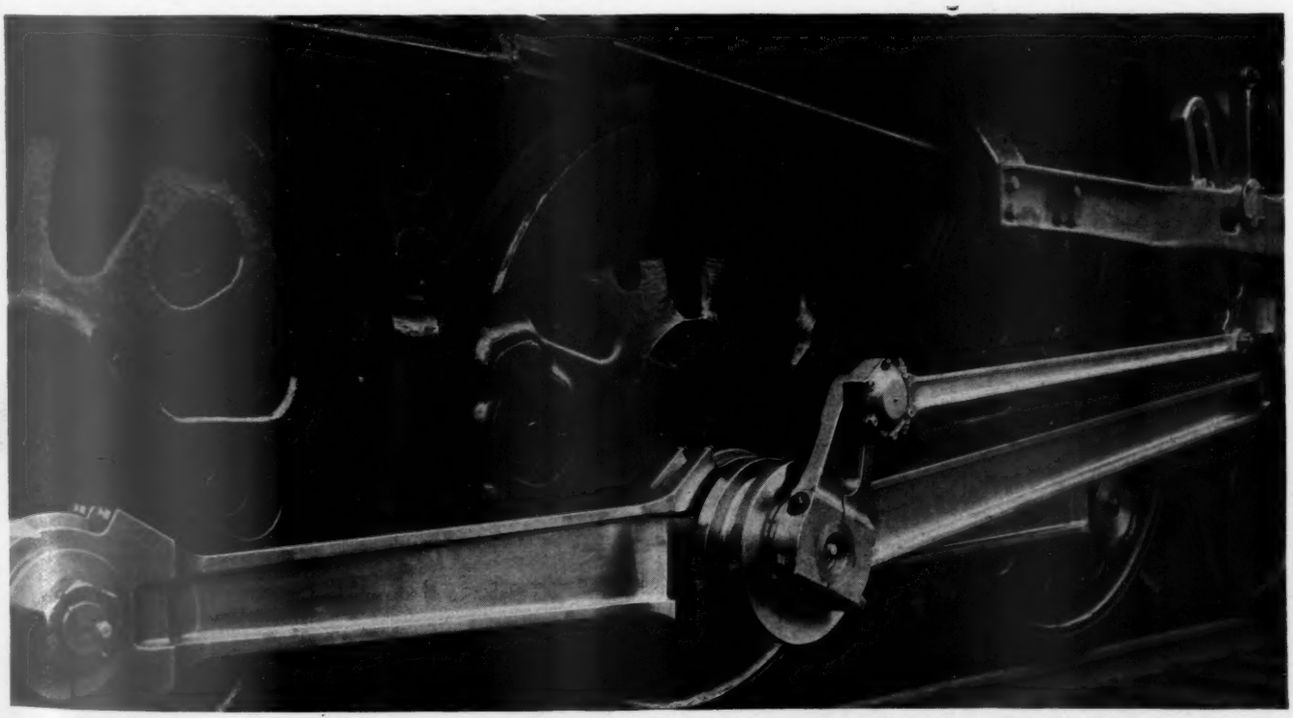
**The lateral cushioning device installed on SKF driving boxes**

wedges, trailing-truck pedestal faces, guides, radial buffer, reverse gear, engine-truck center plate, and trailing-truck center plate.

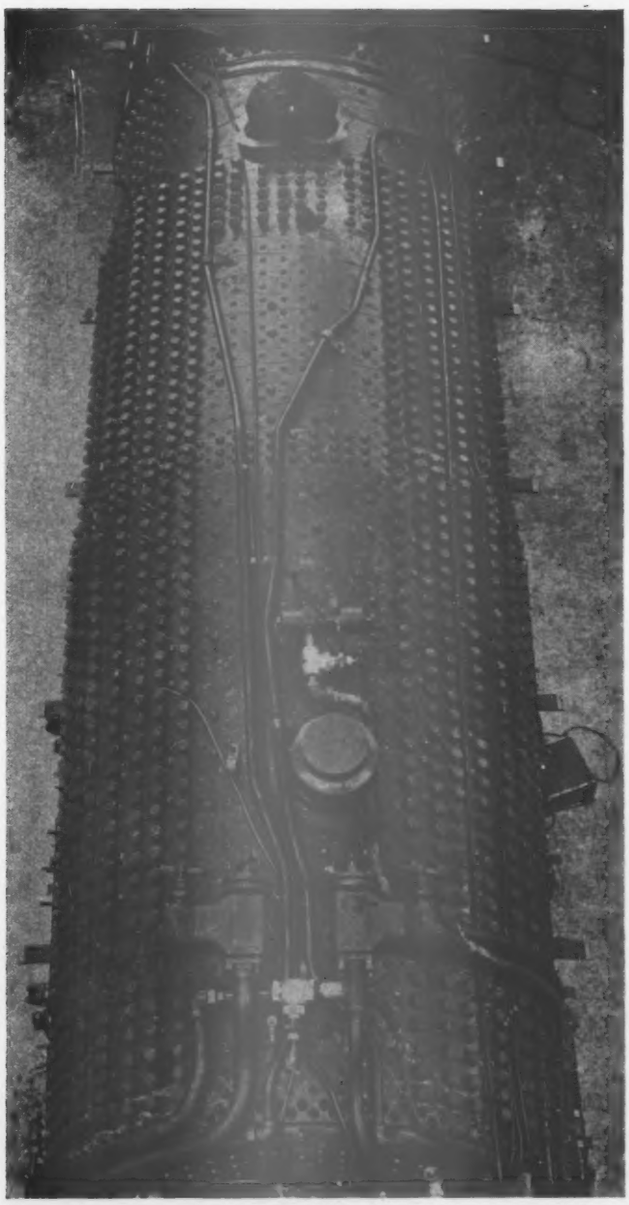
The cab is entirely supported from the boiler, which eliminates the relative movement between the two as the boiler expands and contracts. It is also equipped with the railroad's vestibule curtain arrangement. Between the engine and tender is a Franklin radial buffer.

The tender is a new type of exceptional design and capacity. It has a four-wheel leading truck followed by ten wheels in pedestals, all equipped with roller bearings. It has a cast-steel water-bottom frame with integral cast-in pedestals.

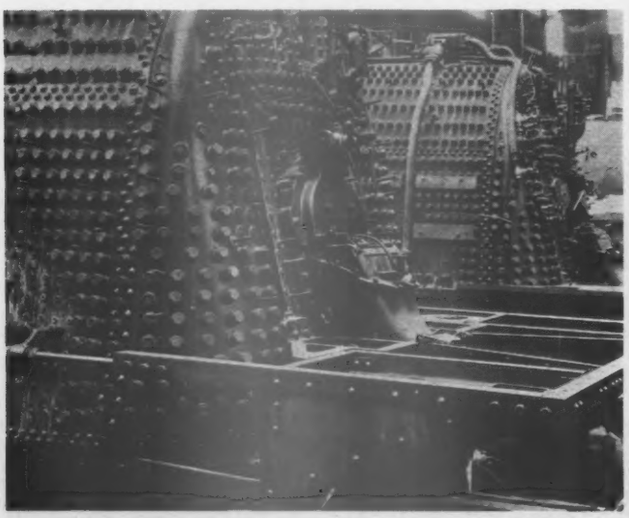
The five pedestal wheels on each side of the tender



**The side rods are connected on the crank pins, without knuckle pins**

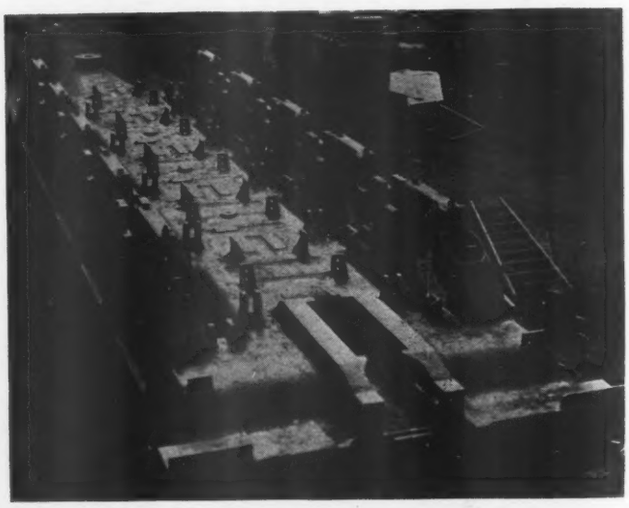


The top of the boiler over the firebox and combustion chamber

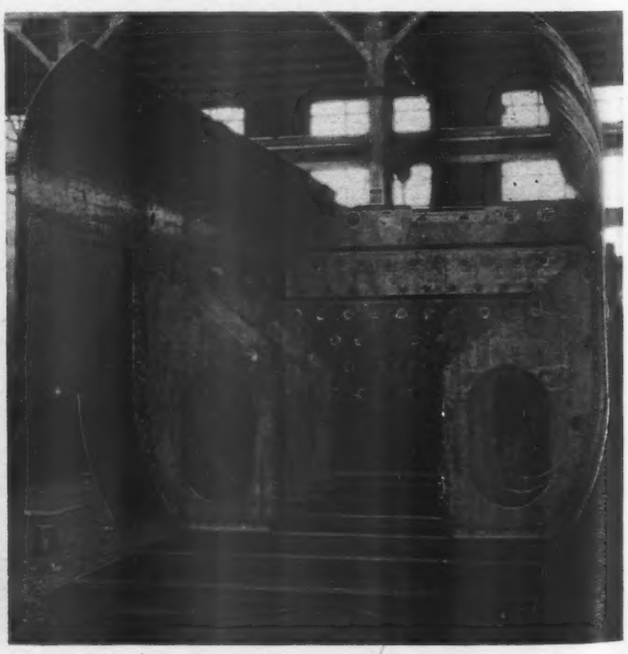


The cab is supported directly on the mud ring and the side of the firebox wrapper sheet

Looking into the rear of the tender water-bottom underframe



The pedestals are an integral part of the tender underframe



Interior of the tender tank before the application of the coal-pit plates

are equalized together, with one semi-elliptic spring and two coil springs over each box. The front and back end of each set of equalization is attached to the frame through a cushioning coil spring. Between each box and the semi-elliptic spring saddle is a Blunt centering device to resist lateral movement. On the front and back axles this resistance is 17 per cent, and on the intermediate axles it is 8 per cent. The Blunt centering device is made up of an upper and lower seat with three intermediate rollers which are engaged by means of gear teeth to the upper and lower seats to insure positive and simultaneous rotation. Each pedestal liner is made up of two hardened spring-steel plates between which is bonded ½ in. of laminated rubber. A total lateral play of 1¼ in. is provided on each side of axles Nos. 3, 4, 5 and 6, and ¾ in. on each side of axle No. 7.

**Comparison of Principal Data for Union Pacific 4-8-4 Type Passenger and Fast Freight Locomotives**

| | 1937 | 1939 |
|---|---|---|
| Date built | | |
| Builder | American Loco. Co. | American Loco. Co. |
| No. built | 20 | 15 |
| Rated tractive force, engine, lb. | 63,600 | 63,800 |
| Weights in working order, lb.: | | |
| On drivers | 270,000 | 270,000 |
| On front truck | 81,200 | 94,000 |
| On trailing truck | 113,800 | 119,000 |
| Total engine | 465,000 | 483,000 |
| Tender | 366,500 | 406,500 |
| Wheel bases, ft.-in.: | | |
| Driving | 21—6 | 22—0 |
| Engine total | 49—3 | 50—11 |
| Engine and tender total | 97—6 | 98—5 |
| Driving wheels, diameter outside tires, in. | 77 | 80 |
| Cylinders, number, diameter and stroke, in. | 2—24½ x 32 | 2—25 x 32 |
| Heating surfaces, sq. ft.: | | |
| Firebox | 422 | 422 |
| Arch tubes | 57 | 57 |
| Firebox, total | 479 | 499 |
| Tubes and flues | 4,118 | 3,971 |
| Evaporat. htg. surface, total | 4,597 | 4,470 |
| Superheat. htg. surface | 1,473 | 1,900 |
| Combined evap. and superheat. | 6,070 | 6,370 |
| Tender: | | |
| Style | 12-wheel | 14-wheel |
| Water capacity, gal. | 20,000 | 23,500 |
| Fuel capacity, tons, level full | 25 | 25 |

The tender leading truck is the General Steel Castings Corporation four-wheel equalized type with a roller centering device providing for 17 per cent initial and 33 per cent constant resistance.

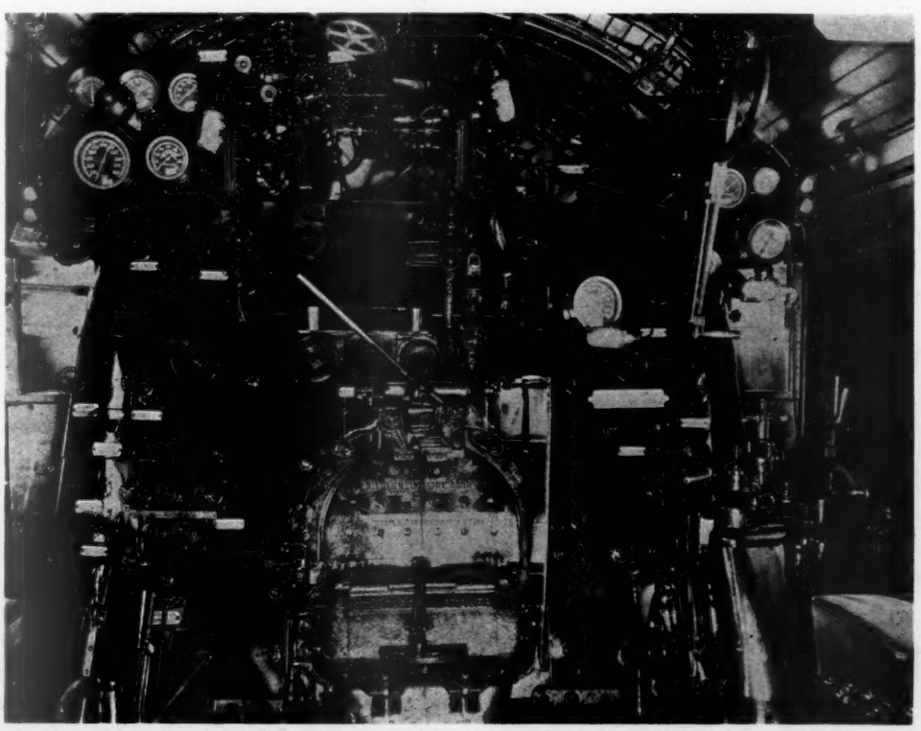
There are clasp brakes on all tender wheels. The truck construction is regular, but there is an individual brake cylinder for each pair of pedestal wheels.

There is no brake on the engine truck, but provision has been made for future application. The drivers do not have clasp brakes, but use extra long brake heads to which two brake shoes are attached. The trailing truck is equipped with clasp brakes. The air brakes are New York No. 8 ET with two 8½-in. cross-compound compressors.

## Locomotives Assigned to Heavy Passenger Service

It was one of the 1937 order of 20 4-8-4 type locomotives built for the Union Pacific by the American Locomotive Company which attained the highest speed in the A. A. R. tests when it handled a 16-car, 1,000-ton train westbound to Grand Island at a maximum speed of 89 miles an hour and, eastbound, on a slightly descending grade, at 102 miles an hour.

The new locomotives will operate in pool between Omaha, Neb.; Cheyenne, Wyo.; Denver, Colo.; Ogden and Salt Lake City, Utah, and Huntington, Ore. The longest through runs are between Omaha and Ogden, 990 miles; Omaha and Salt Lake City, 1,026 miles, and Omaha and Huntington, 1,394 miles. The locomotives will be used largely in conventional passenger-train service. The ruling grade, westbound, in this territory is 1.55 per cent and, eastbound, 1.14 per cent. The locomotives are capable of operating continuously under maximum horsepower output at 90 miles an hour. Calculations were based on 110 miles an hour design speed with 100 miles an hour operating speed. The locomotives will negotiate curves of 20 deg.



Interior of the cab of the Union Pacific 4-8-4 type locomotive

# EDITORIALS

## Why Attend Conventions?

One of the principal industries of America is said to be holding conventions. There are few fields of activity which are not served by an association. In most cases these organizations spring into being almost spontaneously as the leaders in the field realize the need for concerted attack on its common problems.

Membership in most, although not all, of these organizations is purely voluntary. Some of them carry on activities which extend considerably beyond the holding of meetings. The meeting, however, is the medium through which the greater part of their objectives are attained. In the railroad field, attendance at such meetings is usually justified by their inspirational and educational value. Addresses of railway officers are almost always inspirational and frequently of definitely informative value. Committee reports and papers tend to clarify the thinking of all who listen to them and participate in their discussion. Improvements in practice are disseminated much more rapidly than would be possible without the mass contact of those responsible for results from their practical application on the various railroads. Not only is the meeting itself of value in this respect, but considerable store is placed upon the value of the smaller group discussions which develop outside the meeting room.

These advantages of convention attendance have been restated frequently and their validity is quite generally accepted. There is, however, another reason for attendance at conventions and for becoming active in the work of the association in one's field of activity, particularly of those associations in which membership is entirely voluntary. This is the value of association activities in the development of men. One may seem to be adequate in the discharge of his immediate responsibilities and yet never fully develop qualities of independent leadership. To sit through a convention discussion of an acute common problem gives each man a measure of the quality of his own views in relation to those of others of like responsibility. Not only are one's views modified and clarified, but a degree of self confidence is engendered in men possessing any degree of leadership ability which stimulates independent thinking when they get back on the job.

There are executives who are not altogether favorable toward the development of qualities of independence in their subordinates. Such qualities disturb the quiet acquiescence in rules and standards of practice handed down from the top. A man who attends conventions and learns to defend his own views against the world is not likely to acquiesce silently in a rule or method which he believes can be improved. The greater his qualities of leadership and the stronger his character, the more persistent is likely to be his fight for change.

Discipline is an extremely essential quality in a railway organization just as it is in a military organization. One of the qualities which has distinguished the American soldier from others, however, is the degree to which he exercises his own intelligence, in his adherence to discipline and obedience to orders. This same American quality of independence has been invaluable in the development of railway transportation. Some of the recent difficulties of the industry spring from the gradual tendency toward its suppression. The new competitive situation to which the railroads must adjust themselves, and under which they will have to live from now on, demands that this hardening of the arteries be checked and cured.

The good of the industry demands that executives should support—or at least should not directly discourage—the activities of the several voluntary associations of supervisors who come together with the welfare of the railroads at heart as well as for mutual and personal self development. The railroads need men in all positions of responsibility who can stand on their own feet and fight persistently for what they believe to be sound policies and sound methods.

## Off the Record

Certain unofficial aspects of conventions have come in for a good deal of criticism in the past. This is particularly true of some of the private-room entertainment of railroad men by supply men. Such relationships are not to be condemned in themselves. Lack of self control engendered by entertainment of this kind which interferes with the serious purpose of the meetings, however, has done the cause of these associations a great deal of harm.

These meetings present a valuable opportunity to the railway supply field. The ability to contact many users or prospective customers of one's wares at one time and place provides the opportunity for both effective and economical sales effort. It should, therefore, be very much to the interests of the railway supply industry to exercise that degree of responsible control in its relations with railway men at these meetings which will keep the entire institution of associations and conventions in high repute with railway executives.

As far as the railway executives themselves are con-

cerned, they have at times undoubtedly given too much weight to instances of overt lack of self control which were the exception rather than the rule of conduct at these meetings. Such instances cannot help but weaken the standing of the individuals involved. They do not offer valid grounds for the indiscriminate condemnation of associations and convention attendance, however. To hold that they do is to imply that, on the whole, the members of these organizations are incapable of assuming responsibility for their own conduct and that they cannot be trusted to work for the best interests of the industry they serve.

The recent conventions of the four associations of mechanical supervisors at Chicago have a particularly clean record in this respect. Not only was there apparent a keen sense of responsibility in the matter of attending sessions, but wherever groups of men gathered about the hotel during the course of the conventions, the same evidence of a sense of responsibility prevailed.

This comment is inspired by the hope that it may end the use of an obsolete argument against wholeheartedly supporting the work of these organizations.

## Impressions of the Car Officers' Meeting

One of the interesting features of the annual meeting of the Car Department Officers' Association, held at Chicago last month and reported elsewhere in this issue, was the support it received from railway executive officers, including such men as F. G. Gurley, vice-president, Atchison, Topeka & Santa Fe. Mr. Gurley said in effect that the association deserves every possible support because of its objectives and the important part its members play in efficient railroad operation and also because it discusses pertinent problems with a frankness and fearlessness unexcelled by any other organization.

The joint session address by L. W. Baldwin, just preceding the car officers' individual meeting, discussed "Training and Coaching Supervision" and was, of course, very encouraging and stimulating. Some interesting facts were developed in the report of the Publicity Committee which addressed a letter to a number of representative car men throughout the country asking for a frank expression of opinion regarding the potential usefulness of the Car Department Officers' Association, and what steps should be taken to assure that it will achieve maximum effectiveness.

One car department superintendent said "In my opinion, an organization of this nature is of vital importance to the railroads and I think the association should be perpetuated. One of the most important things I feel to insure its continued success is the selection of suitable officers, whereby we may have full assurance that all recommendations developed on car matters are basically sound and practical." Another master car builder said "It is my opinion that the Car Department Officers' Association should be perpetuated. Many things are taking place in the car building art and free discussion of pertinent subjects often brings out some interesting points. Aside from car construction and maintenance discussion, it seems to me that we should give serious thought to young men coming up in the ranks. These men must be encouraged and the association may wish to give this subject consideration for its next meeting."

### Training of Employees Needs Attention

In connection with the subject of employee training and the development of supervisors in the car department, one of the speakers at the meeting said that, as in every great industry, questions involving the human element constitute the most important factor in practically all car-department problems. He referred to the fact that other large industries have made special studies of psychology as influencing every phase of their operation and raised the question if railroads have utilized this highly specialized experience and information to the fullest extent practicable. Apparently they have not, for with few exceptions, railroad managements have failed to organize strong personnel departments designed to give supervisors, including those in the car department, the kind of assistance needed in their important work. Since dealing with the human element is a real problem which receives little official recognition, the thought was advanced and favorably received, that a strong committee of the Car Department Officers' Association might well be appointed and asked to make specific recommendations on this subject in a report at the next meeting.

In a program as well filled with interesting addresses and constructive committee reports as that of the car officers' meeting, it is difficult, and perhaps hardly fair, to say which reports may be considered the more important. The following, however, were so outstanding as to deserve special mention: Shop Operation Facilities and Tools, Passenger-Train-Car Terminal Handling, Freight-Car Inspection and Preparation for Commodity Loading, and Equipment Painting.

With a total attendance of over 300, and in view of the general interest displayed, the association should feel encouraged to increase its activities during the coming year. Doubtless, new subjects will be suggested from time to time for the consideration of the association and one of these, not presented this year, is the question of maintaining air-brake equipment to meet the demands of modern high-speed train operation. With the former Air Brake Association not actively functioning, it would seem logical that operating problems associated with the use of air brakes should be considered by the Railway Fuel and Traveling Engineers' Association, whereas problems involved in the inspection and shop repairs of all air-brake equipment used on cars, particularly methods of repairs,

would come logically within the scope of the Car Department Officers' Association.

Problems of car shop production, machine equipment, scheduling of work and training personnel are obviously within the field of investigation covered by the Car Department Officers' Association, which is confronted with a definite challenge to develop constructive information on all of these subjects. The association will need no other press agent and no more persuasive advocate in justifying its existence to railroad managements than a set of constructive committee reports which contain so much timely and vital information that they are kept and constantly referred to when printed in the annual proceedings of the association.

## The Art of Leadership

So far as the mechanical details of their activities are concerned, the members of the four railway associations which held their conventions at the Hotel Sherman, Chicago, last month, have little in common except that they are associated with the mechanical department. One golden strand, however, is woven through the substantial homespun fabric of all of their tasks. A golden thread, because it is the most valuable and the most vital, although it is to be feared that it is often over-shadowed by the multiplicity of other plain threads which, in the sight of those without perception and vision, appear to dominate and control the pattern.

That the golden thread in the programs was so pronounced this year is partly due to those who built the program of the Locomotive Maintenance Officers' Association. It was that group which persuaded L. W. Baldwin, chief executive officer of the Missouri Pacific Lines, to talk to them about the training and coaching of supervisors. The other organizations, when they learned of this, insisted that so rare a treat should be shared by all of them; and Mr. Baldwin was the honor guest at the great joint opening meeting of the five groups, including the Allied Railway Supply Association. And it is well that he should be, since he is one of the few chief executives who have been persistent in insisting on the importance of the human element in the organization and its proper supervision.

Mr. Baldwin is an engineer by training and from his performance, at least, a believer in the more modern definition of engineering: "Engineering is the science of controlling the forces and of utilizing the materials of nature *for the benefit of man, and the art of organizing the human activities in connection therewith.*"

"Organizing the human activities" in industry or on the railroads is indeed an art, and one which should be mastered by every supervisor, from the gang boss to the top executive. That this has not been very well done in the past is responsible for many needless misunderstandings in industry and on the railroads, which have cost this nation and its workers billions of dollars. Resort to force in adjusting labor difficulties —and it has not been done away with by any means— is just as useless and just as wasteful as is war between nations.

But why refer to the extremes? The little and seemingly unimportant difficulties and misunderstandings which occur in every department, every day, in the aggregate are a source of great waste and lowering of efficiency. A little haziness as to just what is expected from the worker will dull his enthusiasm about the job. Little unintentional and thoughtless actions and attitudes on the part of the boss may cause discouragement and resentment. These and many other things are due to lack of adequate coaching and instruction, and all tend to slow down production and lower the standards of the output. Well trained supervision offers the great opportunity for increasing the efficiency of railroad operation and maintenance.

The golden thread supplied by Mr. Baldwin was supplemented in various ways in the programs of all four associations, either by design or by spontaneity of expression. In the Locomotive Maintenance Officers' Association, for instance, another executive, Trustee Frederic E. Lyford, of the New York, Ontario & Western, picked up the thread and wove it even more intimately into the pattern in his discussion on "What I Expect of My Supervisors, and Why?" His message was driven home by a statement that "good equipment is fine, but good men are better—you can do a lot with good men and poor equipment, but not much with good equipment and poor men."

### Learn to Compose Internal Differences

America, by sane and peaceful methods, must set an example to the warring nations of the world as to how their differences may be composed in an orderly fashion, without destruction and waste. We cannot do this successfully unless we first learn how to compose our own internal differences. In spite of our shortcomings it must be admitted that, considering the fact that the mass production era only started in this country after the beginning of the century, we have made very considerable progress in improving human relations in industry. The leaders who have pioneered in this respect have developed what can well be designated as the science of industrial supervision. The principles are well known, if one cares to take the time to master them. A great forward step will be taken when we recognize more generally the fact that successful supervision is an art. Fundamentally, it is based on an understanding of human nature and the application of the Golden Rule.

In a real sense, therefore, industry in solving its human relations problem—and it has made substantial progress in this respect in this country—is helping to supply the answer to the solution of international relationships, since that, too, is primarily a human relations problem.

# THE READER'S PAGE

## Deflection Under Load

To the Editor:

The editorial "Deflection Under Load," appearing in the June *Railway Mechanical Engineer* is very well written and clearly points out the well-known fact to designing engineers that tensile strength has practically no relation to the stiffness of steel as the modulus of elasticity is almost constant for a given section of steel regardless of its tensile or strength properties.

I think the last paragraph of the editorial is very pertinent and it is approaching a tragedy in passenger-car design for the future for the A. A. R. to adopt a recommended specification for passenger cars which has so little relation to the actual design and ultimate strength requirements. To add weight to the underframe promiscuously can, as a whole, produce a weak structure and particularly create a car having considerable deflection, making it hard to keep partitions and other inside finish in proper alinement and free from noise or squeaking.

A specification as important as for a passenger car should not, and in fact cannot be developed in a few weeks time. To approach an ideal passenger-car construction, considerable more attention will have to be given to the sides and particularly the roof construction of the car. To many designers the roof construction is equally as important as the underframe construction. If the two are carefully balanced and properly designed, and advantage is taken of skin stresses as in airplane design, a passenger-car structure can be produced approaching present general over-all dimensions with very little deflection, or at least a deflection which is entirely within the safe and practical limits.

K. F. Nystrom,
*Mechanical assistant to chief operating officer, Chicago, Milwaukee, St. Paul & Pacific.*

## Worn Rod Bushings Are Still Serviceable

To the Editor:

Quite often a substantial saving in repair expense may be made, particularly in a small shop, by saving rod bushings that are smaller in bore than the pin sizes for certain pins and larger in outside diameter than certain standard rod eye sizes. It doesn't take much time to check these old bushings in order to determine whether or not they may be made use of. By saving old bushings that meet the requirements as to measurement I have several times been able to renew nearly a whole set of rod bushings without ordering more than one or two new ones from the storehouse.

The same thing is true of the split bushings as of solid ones. In the case of back-end strap brasses and middle connection brasses it is quite often that only one half of a pair of brasses need be scrapped so that where an engine comes in with half of a brass broken an old half brass can be used to make up the pair. What has been said above also may apply to floating bushings.

W. E. Howard

## Detecting a Worn-Through Chill

To the Editor:

A letter appeared recently in the pages of *Railway Mechanical Engineer* concerning the detection of worn-through chill spots in wheels by color. The inference in the letter was to the effect that the Wheel and Axle Manual makes no reference to color as a method of detecting worn-through chill. Paragraph 102, page 115, of the Wheel and Axle Manual reads, in part, as follows: "When the chilled metal, or white iron, is worn through, the soft grey iron is exposed and flattened out."

It appears to me that this is a very direct reference to color determination for this defect.

Reader

## Piston Rod and Wrist Pin Failures

To the Editor:

The locomotive designer, by using a high factor of safety, makes allowances for the unusual loads the piston rods and the wrist pins must carry due to water in the cylinders, excessive compression pressures, and lost motion between the crosshead and guides. Failures of these parts can seldom be laid to lack of judgment on the part of the designer.

The breaking of piston rods just inside the tapered fit in the crosshead, to my mind, is caused by excessive driving of the piston-rod key which stretches the metal, leaves a permanent set, and produces a possible fracture. Piston-rod keys do not get loose unless the tapered fit has been disturbed and, therefore, the fit should be examined when the key is found to be loose. When it becomes necessary to disconnect the piston rod from the crosshead, care should be taken to scribe a mark on the piston-rod key before it is driven out and good judgment should be used in driving the key to the same mark when it is again applied.

The breaking of wrist pins can also be charged to metal stretch. If a wrist pin is a poor fit, then trying to keep it tight by using a box wrench and a sledge hammer is apt to cause these pins to fracture at the throat fillet or in the threads. Again, when a castle nut is applied to the wrist pin and tightened but is not in the right position to line up with the cotter-pin hole, then a few more blows with the sledge on the wrench to turn the nut to the proper position may also cause a fracture of the pin.

To save a lot of damage the mechanic should have in mind the power of the screw and wedge.

W. W. Edgar

# *High Spots in*
# Railway Affairs . . .

### Railroad Earnings Picking Up

The net income after fixed charges of the Class I railroads in August was $10,053,000. This compares with a net deficit of $1,181,000 in August of last year. While this, of course, is a source of gratification, the fact must not be overlooked that these earnings were very small compared with the railroad investment, and also that there was a net deficit after fixed charges for the eight months of this year amounting to over $74,000,000. Business prospects are good, but the railroads have a long way to go before they can face the future with confidence.

### Building Up Railway Forces

Railway employment climbed to 1,019,063 in mid-September and undoubtedly, with increased business and more intensive activities in taking up deferred maintenance, it will continue on its way upward. This was an increase of 5.77 per cent over the same time last year. The maintenance of equipment and stores forces were up 9.98 per cent, the maintenance of way and structures forces 6.2 per cent, and the train and engine services group 3.8 per cent over last year. There was a reduction in only one of the classifications, that including executives, officials and staff assistants, which was off 0.41 per cent.

### In Time of War

The railroads and mass transportation are essential in times of national emergency and particularly in case of war. Serious mistakes were made in the use of the railways by the government in the first World War. Let us devoutly hope we will not be drawn into the present conflict. In case we are, however, the railroads, the Army and the Navy are prepared to make the best possible use of that form of transportation. In the first place, the practices in handling freight traffic by the railroads have been almost revolutionized in the past two decades and we can make very much better use of the equipment today than during the first World War. In the second place, much of the trouble in the first World War was caused by the unintelligent exercise of priorities and the piling up of loaded cars at shipping ports, where they were used for storage purposes over considerable periods, rather than being promptly unloaded. With such handicaps removed, little fear need be had of a breakdown of the railroads, if the equipment is maintained in good condition and ample additions are made to it in the coming months.

### Rebuilding Passenger Traffic

For a full decade, 1924-33, railway passenger traffic declined in this country. Since 1934, however, it has increased consistently. Why? Very largely because of the courage and initiative of those roads which have installed high speed, streamlined passenger equipment and which have modernized their passenger services. In commemoration of this achievement the Railway Age published a Passenger Progress Number on October 14. In the five years, 1934-38, inclusive, an annual average of 34,171,771 more passengers have used railway trains for each year.

### Back-Breaking Burden

The Class I railroads in the calendar year 1938 paid 9.5 cents in taxes for each dollar of operating revenue. This included federal, state and local taxation, which amounted to 40.41 cents out of every dollar of net earnings. This at least partially explains why so many railroads find themselves in financial difficulties. The Administration and Congress don't seem to be showing any very great concern over the welfare of this backbone of our transportation system, which is regarded as absolutely indispensable and vital in times of national emergency.

### Higher Speeds Not Detrimental to Safety

In speaking before the Steam Railroad Section of the National Safety Congress at Atlantic City on October 19, M. J. Gormley, executive assistant, Association of American Railroads, made the following significant statement: "In 1923 there were 31 fatal and non-fatal injuries to employees on duty for each million man-hours worked. In 1938 there were less than 7 casualties per million man-hours. * * * * It is significant that this improvement in employee safety took place during the period of greatest relative increases in average speed and average load of trains. In the freight service, average speed of freight trains between terminals increased 52 per cent from 1923 to 1938, and the average number of cars per train increased 21 per cent. During this same period of years, the casualty rate of road freight train and engine service employees was reduced 64 per cent for each million man-hours worked. In the passenger service, trains were also speeded up, new lightweight trains of streamlined design were introduced, and the standard of the service was generally raised. Road train and engine service employees in passenger service were 66 per cent safer in 1938 than in 1923. In yard service, train and engine employees were 72 per cent safer." Mr. Gormley also drew attention to the fact that there was a decline of 86 per cent in casualty frequency in the maintenance of equipment group in 1938, as compared to 1923.

### New York World's Fair Railroad Exhibit

While the railroad exhibit at the New York World's Fair was not publicized nearly so effectively as that of the General Motors across the way, it proved to be one of the best drawing cards on the grounds. The Eastern Presidents' Conference, which sponsored the exhibit, held a meeting in New York on October 19, on which occasion it was decided to take the same space, 17½ acres, next year.

### Good Record in Reducing Fire Losses

One of the great wastes in this country is that caused by fire. The railroads have made a determined effort to reduce these losses on their properties and with excellent results, although they still amount to a considerable sum. For the calendar year 1938, 4,372 fires resulted in a loss of $3,820,214. Smoking was the cause of 331 fires, with a loss of $320,878. Locomotive sparks and hot coals accounted for 288 fires, with a loss of $163,732. A loss of $499,874 resulted from 1,036 fires which occurred in box cars. It is interesting to compare the loss in 1938 with the average per year for the past 20 years of 6,820 fires and loss of $6,184,735. The record for the past six years has been particularly good, the average loss amounting to only $3,638,323 a year. The excellent work that has been done can readily be seen by comparing this with the average of $9,324,753 for the six years 1919-24, at the beginning of the 20-year period.

# Among the Clubs and Associations

CENTRAL RAILWAY CLUB OF BUFFALO.—Meeting November 9. Speaker: T. V. Buckwalter, vice-president, The Timken Roller Bearing Company. Subject: Steam Locomotive Slipping Tests.

NEW ENGLAND RAILROAD CLUB.—Meeting November 14, Hotel Touraine, Boston, Mass. Dinner 6:30 p. m. Speaker, E. H. Roy, general superintendent motive power, Seaboard Air Line. Subject: Diesel Locomotive Application—S. A. L.

TORONTO RAILWAY CLUB.—Meeting 7:45 p. m., November 20, Royal York Hotel, Toronto, Ont. Speaker: Harry Thomason, Canadian Westinghouse Company. Subject: Electric Welding and Shop Practice.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—Meeting November 21, 8 p. m., Hotel DeSoto, St. Louis, Mo. Speaker: S. O. Taylor, master car builder, Missouri Pacific. Subject: Training of Supervision.

NORTHWEST CAR MEN'S ASSOCIATION.—Meeting November 6. Speaker: H. L. Heater, vice-president in charge of engineering, American Steel Foundries. Subject: Freight-Car Truck Design and Construction.

CANADIAN RAILWAY CLUB.—Meeting November 13, 8:15 p. m., Rose Room, Windsor Hotel, Montreal, Que. Speaker: Burt Anderson, general sales manager, Union Switch & Signal Company. Subject: Operation of Trains by Centralized Traffic Control. Moving pictures.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—At the annual meeting of the Car Foremen's Association of Chicago, held at the La Salle Hotel, on October 7, the following officers were elected for the ensuing year: President, W. J. Healion, superintendent, North American Car Corporation, Blue Island, Ill.; first vice-president, C. A. Erickson, general A. A. R. inspector, Chicago & North Western, Chicago; second vice-president, W. A. Emerson, general master car builder, Elgin, Joliet & Eastern, Joliet, Ill.; treasurer, C. J. Nelson, superintendent of interchange, The Chicago Car Interchange Bureau, Chicago; secretary, Geo. K. Oliver, assistant passenger car foreman, Baltimore & Ohio Chicago Terminal, Chicago. ¶ By virtue of his election to the presidency, Mr. Healion becomes chairman of the Board of Directors. The only other change in the board was the replacement of Mr. Emerson, who was elected vice-president, by Phil Baker, master mechanic, Belt Railway Company of Chicago, Chicago.

A. S. M. E., METROPOLITAN SECTION.—High-Speed Lightweight Trains will be the subject of a paper which will be presented by C. T. Ripley, chief engineer, Technical Board, Wrought Steel Wheel Industry, at a meeting of the Metropolitan Section of the American Society of Mechanical Engineers which will be held at the Engineering Societies building, 29 West Thirty-Ninth street, New York, on Tuesday evening, November 21, at 7:30 p. m. Mr. Ripley's paper was prepared as the American contribution to the railway session of the British-American Engineering Congress which would have been held at New York early in September had it not been for the war developments in Europe which led to the cancellation of the congress. It deals with the development of lightweight passenger rolling stock and even more extensively with motive-power developments and their implications. Roy V. Wright, editor, *Railway Mechanical Engineer,* will be chairman of the meeting.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The following new officers for 1940 have been elected by a letter ballot of the entire organization of 15,000: President, W. H. McBryde, consulting engineer, San Francisco, Calif.; vice-presidents, K. H. Condit, executive assistant to the president, National Industrial Conference Board, New York; Francis Hodgkinson, retired consulting mechanical engineer, Westinghouse Electric & Manufacturing Co., New York; J. C. Hunsaker, aeronautical engineer, Cambridge, Mass., and K. M. Irwin, assistant to vice-president, Philadelphia Electric Company, Philadelphia, Pa. Managers, J. W. Eshelman, sales engineer, Birmingham, Ala.; Linn Helander, professor of mechanical engineering, Kansas State College, Manhattan, Kansas; and G. T. Shoemaker, president, United Light & Power Service Company, Chicago.

NORTHWEST CARMEN'S ASSOCIATION.—At the annual meeting of the Northwest Carmen's Association, held at the North Central Club, St. Paul, Minn., on October 2, an unusually large and representative group of members was present to listen to the committee reports, enjoy the clever and extensive entertainment program provided and elect officers for the ensuing year. A total of 433 members and guests of the association registered for the meeting and much pleasure was expressed at the secretary's report of 161 new members since the September meeting and the treasurer's statement of a cash balance on October 1, 1939, of over $1,400. ¶ The report of the Nominating Committee was accepted and, by a single unanimous ballot, the following officers were elected for next year: President, F. M. Washburn, car foreman, C. M. St. P. & P., Minneapolis, Minn.; first vice-president, J. M. Ryan, master car builder, C. St. P. M. & O., Hudson, Wis.; second vice-president, G. A. Thomson, car foreman, N. P., St. Paul, Minn.; third vice-president, L. R. Kassick, general foreman freight cars, M. St. P. & S. S. M., Minneapolis, Minn.; secretary, E. M. Myers, chief interchange inspector, Minnesota Transfer, St. Paul, Minn.; treasurer, G. R. Johnson, chief clerk to master car builder, N. P., St. Paul, Minn.

## P. & S. Division Selects Committees

FOLLOWING a recent meeting of its general committee, the Purchasing and Stores division, A. A. R., of which A. C. Mann, vice-president, Illinois Central, is chairman, has announced the subjects to be studied by committees this year and the personnel of each committee. Seventeen committees have been assigned to prepare reports. An advisory committee, consisting of the past chairmen of the Division, has been reappointed, with E. A. Clifford, general purchasing agent, C. & N. W., as chairman, a special purchasing committee has been reappointed, with L. L. White, vice-president, Erie, as chairman, and the committees in charge of regional meetings have been reorganized. The subject committees are as follows:

*Purchasing and Stores Manual:* P. L. Grammer, assistant purchasing agent, Penna., chairman.
*Material Classification:* E. G. Roberts, general storekeeper, C. R. I. & P., chairman.
*Railroad Scrap:* R. E. Hamilton, supervisor reclamation, C. & O., chairman.
*General Reclamation (Joint with Mechanical and Engineering Divisions):* E. R. Casey, superintendent of reclamation, Union Pacific, chairman.
*Material Records—Pricing-Inventory:* C. K. Reasor, assistant manager of stores, Erie, chairman.
*Forest Products:* J. E. McNelley, chief tie and lumber supervisor, A. C. L., chairman.
*Fuel:* P. A. Hollar, fuel purchasing agent, Penna., chairman.
*Purchasing Department Practices:* W. A. Clem, purchasing agent, Reading, chairman.
*Stationery and Printing:* B. B. Melgaard, assistant to purchasing agent, C. M., St. P. & P., chairman.
*Handling Facilities:* W. F. Redman, traveling storekeeper, C. & N. W., chairman.
*Simplification and Standardization:* A. G. Follette, general material supervisor, Penna., chairman.
*Supplies for Dining Cars:* J. F. McAlpine, assistant purchasing agent, C. B. & Q., chairman.
*Engineering Materials:* G. D. Tombs, division storekeeper, I. C., chairman.
*Standard Packages:* F. S. Austin, assistant purchasing agent, N. Y. C., chairman.
*Stores Practices and Records:* J. S. Genther, general storekeeper, L. & N. F., chairman.
*Marking Tools, Materials, Etc.:* W. H. Lloyd, division storekeeper, C. R. I. & P., chairman.
*Loss and Damage:* J. T. Kelly, general storekeeper, C. M., St. P. & P., chairman.
*Regional Committees: Purchasing.* Eastern—C. C. Warne, purchasing agent, N. Y. C.;

Southern—H. E. Warren, manager purchases and stores, G. M. & N.; Western—W. W. Kelly, general purchasing agent, A. T. & S. F.; Southwestern—J. H. Lauderdale, general purchasing agent, Mo. Pac.; Far Western—G. M. Betterton, purchasing agent, S. P. *Stores.* Eastern—W. R. Culver, superintendent of stores, C. & O.; Southern—C. H. Murrin, general storekeeper, L. & N.; Western—J. T. Kelly, general storekeeper, C. M., St. P. & P.; Southwestern—C. L. Wakeman, general storekeeper, Wabash; Far Western—U. K. Hall, general storekeeper, Union Pacific.

## Sixtieth Annual A.S.M.E. Meeting To Be Held at Philadelphia

THE usefulness of the mechanical-engineering profession is to be stressed at the sixtieth annual meeting of the American Society of Mechanical Engineers to be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., December 4-8. This meeting at Philadelphia will be the first annual gathering of the society to be conducted outside of New York City since 1890 and the first national meeting in Philadelphia since 1887. Ninety-seven papers will be presented at the 33 technical sessions. Of particular interest to railroad men will be the following:

Monday, December 4

8 p. m.

MACHINE SHOP PRACTICE

A New Method of Machine-Tool Spindle Analysis, by Thomas Barish
Machine Design and Motion Economy—Building Motion Economy into Machine Tools, by O. W. Habel and G. G. Kearful

Tuesday, December 5

9 a. m.

FUELS

Which Fuel to Choose? by G. A. Anbro
Modern Methods of Fuel Purchasing, by R. G. Rincliffe

2:30 p. m.

FUELS

Characteristics of Cloth Filters on Coal-Dust Air Mixtures, by A. R. Mumford, A. A. Markson, and T. Ravese
Defining Equitable Limits of Dust Emmission from Stacks, by P. H. Hardie

Wednesday, December 6

9:30 a. m.

EDUCATION AND TRAINING

Education and Training of Apprentices for the Aeronautical Industry, by Victor W. Page
Apprentice Training, by Ray E. Ellis
Apprenticeship in the Machine-Tool Industry, by Elmer H. Neff

LUBRICATION (I)

The Influence of Crystal Size on the Wear Properties of High-Lead Bearing Metal, by John R. Connelly
Temperature Distribution in Bearings, by E. S. Pearce

2:30 p. m.

LUBRICATION (II)

Boundary Film Investigation, by S. J. Needs
Properties and Performance of Plastic Bearing Materials, by L. M. Tichvinsky

6:30 p. m.

Banquet and Honors

Thursday, December 7

9:30 a. m.

RAILROAD

Railway-Car Engineering, by D. S. Ellis
Whip Stress in a Locomotive Main-Rod at 100 M. P. H., by M. W. Davidson (by title)
Progress in Railway Mechanical Engineering, 1938-1939

MECHANICAL SPRINGS

Calculation of the Elastic Curve of a Helical Compression Spring, by H. C. Keysor
Helix Warping in Helical Compression Springs, by D. H. Pletta and F. J. Maher
Progress Report—Fatigue Tests of Helical Compression Springs at Wright Field, by C. T. Edgerton
Progress Report on Book on Strength of Metals, by D. J. McAdam, Jr.

THERMODYNAMICS

A Rational Representation of the Flow Performance of Reaction Steam-Turbine Blading, by Adolf Egli
The Viscosity of Superheated Steam, by G. A. Hawkins, H. L. Solberg, and A. A. Potter
Report on Change of Enthalpy of Steam with Pressure at Low Temperatures, by F. G. Keyes

2:30 p. m.

STEAM GENERATORS

Steam Boiler Performance and a Method of Comparison, by E. G. Bailey
The Locomotive Boiler, by C. A. Brandt

## New Coordination Committee for Mechanical Associations

FOLLOWING the close of the meetings of the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, the Master Boiler Makers' Association, and the Locomotive Maintenance Officers' Association at Chicago on October 19, the Committee on Coordination of Conventions was reorganized. Under the chairmanship of Frank Roesch, vice-president, Standard Stoker Company, this committee has long been active in promoting the present arrangement of simultaneous meetings, with a combined exhibit when one is held. Following the recommendation of its chairman, Mr. Roesch, in his report before the joint session of the four associations, that the committee be discharged and a new committee organized to carry on the arrangements for the coordinated meetings, the old committee has been discontinued and a new Committee of the Coordinated Associations takes its place. This committee, of which the president and secretary of each of the associations are members, elects its own officers. Frank Roesch was reelected chairman and T. Duff Smith, secretary-treasurer of the Railway Fuel and Traveling Engineers' Association, was elected secretary. In addition to the four railway associations, the Allied Railway Supply Association is represented on the committee. Included in its duties are convention and exhibit arrangements. It is also available to serve as a coordinating agency to avoid conflicts in the programs of the four associations.

## DIRECTORY

*The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:*

AIR-BRAKE ASSOCIATION.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

MACHINE SHOP PRACTICE DIVISION.—Erik Aberg, editor, Machinery, 148 Lafayette street, New York.

MATERIALS HANDLING DIVISION.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—M. J. Reed, 2 West Forty-fifth street, New York.

FUELS DIVISION.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

ASSOCIATION OF AMERICAN RAILROADS.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting, June 28, 29 and 30, at the Commodore Hotel, New York.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4468 Oxford avenue, N. D. G., Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, DeSoto Hotel, St. Louis, Mo.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Meeting, October 17, 18 and 19, Hotel Sherman, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMEN'S ASSOCIATION. — Roy MacLeod, Room 127, General Office Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of January, February, March, April and October at Engineering Societies Bldg., 29 West 39th street, New York.

INDIANAPOLIS CAR INSPECTION ASSOCIATION. — R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION. — See Railway Fuel and Traveling Engineers' Association. Meeting third week in October, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—See Locomotive Maintenance Officers' Association.

LOCOMOTIVE MAINTENANCE OFFICERS' ASSOCIATION.—F. T. James, division master mechanic, D. L. & W., Hoboken, N. J.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting, October 17, 18, and 19, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB. — W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Thursday in each month, except June, July, August, September and December at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

PACIFIC RAILWAY CLUB. — William S. Wollner, P. O. Box 3275, San Francisco, Cal. Monthly meetings alternately in northern and southern California.

RAILWAY CLUB OF GREENVILLE.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, 1255 Old Colony building, Chicago. Annual meeting October 17, 18, and 19, Hotel Sherman, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION. —J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

TRAVELING ENGINEERS' ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

VALLEY ANTHRACITE CAR FOREMEN'S ASSOCIATION.—P. P. Kohl, executive secretary, 254 Barney street, Wilkes-Barre, Pa. Regular meetings third Monday of each month.

WESTERN RAILWAY CLUB.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.



(*Turn to next left-hand page*)

# *Another Step FORWARD*

**The new heat treating method developed by our Research Department has so thoroughly proved its value that today, only three years after its introduction, approximately 1000 of these unit pits, with a total capacity of 23,000 wheels, are operating, and 85% of all our production of chilled car wheels is made better by their use.**

## ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE,
NEW YORK, N. Y.

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**ORGANIZED TO ACHIEVE:**
**Uniform Specifications**
**Uniform Inspection**
**Uniform Product**

*Photo by Corcoran of Globe*

# NEWS

## 1939 Mechanical Division Letter Ballot Results

IN Circular No. DV-969, issued under date of October 23, by the Association of American Railroads, mechanical division, the results of the letter ballots on recommendations of various committees reporting to the session of the division at New York, June 28-30, 1939, are given in detail, a total of 74 individual propositions being involved. As a result of a favorable letter ballot all of these propositions to amend the standard and recommended practice of the division are approved effective March 1, 1940; with the exception of Proposition 4 (a) to 5 (c), inclusive, covering definitions and designating letters which are approved effective immediately; and with the further exception of Propositions 3, 6, 7, 23, 26, 27 and 28 to amend the interchange rules, and Propositions 29 to 74, inclusive, to amend the loading rules, these propositions being approved effective January 1, 1940.

## A. A. R. Completes Car-Truck Tests

TESTS under actual operating conditions to determine what improvements can be made in the construction of railroad car trucks to enable them to meet with still greater safety, further increases in the speed of freight trains have been completed by the Association of American Railroads according to a recent announcement. The engineers in charge of these tests are now engaged in correlating the data and expect to have a final report early in 1940.

These tests, the most comprehensive of their kind ever conducted by the railroads, began last April and since that time more than 70 test runs at speeds as high as 85 miles per hour were made on the Pennsylvania between Altoona, Pa., and Lock Haven, a round trip of about 150 miles.

Twelve different types of trucks were used in the tests which were made under varying speed, load, weather and operating conditions. In order to determine their qualities or defects, each truck was submitted to a series of separate test runs under a standard freight car which was part of a train containing electrical recording devices, gauges and other paraphernalia designed to record each impulse of the truck under different speed and load conditions.

Simultaneously, tests also were made for the purpose of determining the impact effects on the track of the various makes of trucks. In order to do this an elaborate system of electrical devices was set up along the track to register the impact blows delivered by the wheels of the trucks passing over the rails.

In the past 18 years, the A. A. R. statement points out, there has been an almost constant increase in the average speed of trains with the result that in the first half of 1939, the average speed between terminals was 64 per cent greater than in 1920. As a matter of fact, many freight trains now operate on what formerly were passenger-train schedules.

The road tests which have just been completed were conducted under the general direction of W. I. Cantley, mechanical engineer, Mechanical Division of the Association of American Railroads. W. E. Gray, engineer of draft gear tests was in direct charge of the road tests. G. M. Magee, research engineer of the Engineering Division was in general charge of the track impact tests.

## Equipment-Purchasing and Modernization Programs

*Atchison, Topeka & Santa Fe.*—An improvement program to be undertaken by this road involves the expenditure of approximately $21,000,000 for the purchase of 91,000 tons of rails and fastenings, and 2,800 freight cars, the rebuilding of 2,500 box, auto and refrigerator cars in company shops, an accelerated locomotive and car repair program, and the double tracking of twenty-four miles of its main line from D. T. Junction to Joseph City, Ariz.

The freight cars to be purchased include 1,800 box cars, 200 coal cars, 100 flat cars, 450 refrigerator cars, and 250 gondolas. The box cars will be standard 100,000 lb. capacity cars with roofs lined with an absorbent material to prevent condensation of moisture. Of the refrigerator cars, 300 will be of 40 ft. and 150 will be 50 ft. long. The flat cars will be 70 ft. long and particularly adapted for loading farm machinery and farm implements. The mill-type gondolas will be 56 ft. and 65 ft. long and will be used in special service for loading structural steel. Of the cars to be rebuilt, 900 box cars will be reconstructed in the Topeka shops, 600 automobile cars at the Empire shops in Chicago and 1,000 refrigerator cars at the Wichita shops.

*Chicago, Burlington & Quincy.*—As reported in the October *Railway Mechanical Engineer*, the C. B. & Q. having been authorized by its directors to acquire locomotives and freight cars, is now asking for prices to determine whether the 10 Mohawk 4-8-4 type locomotives, the 100 53½ ft. flat cars of 50 tons' capacity and the

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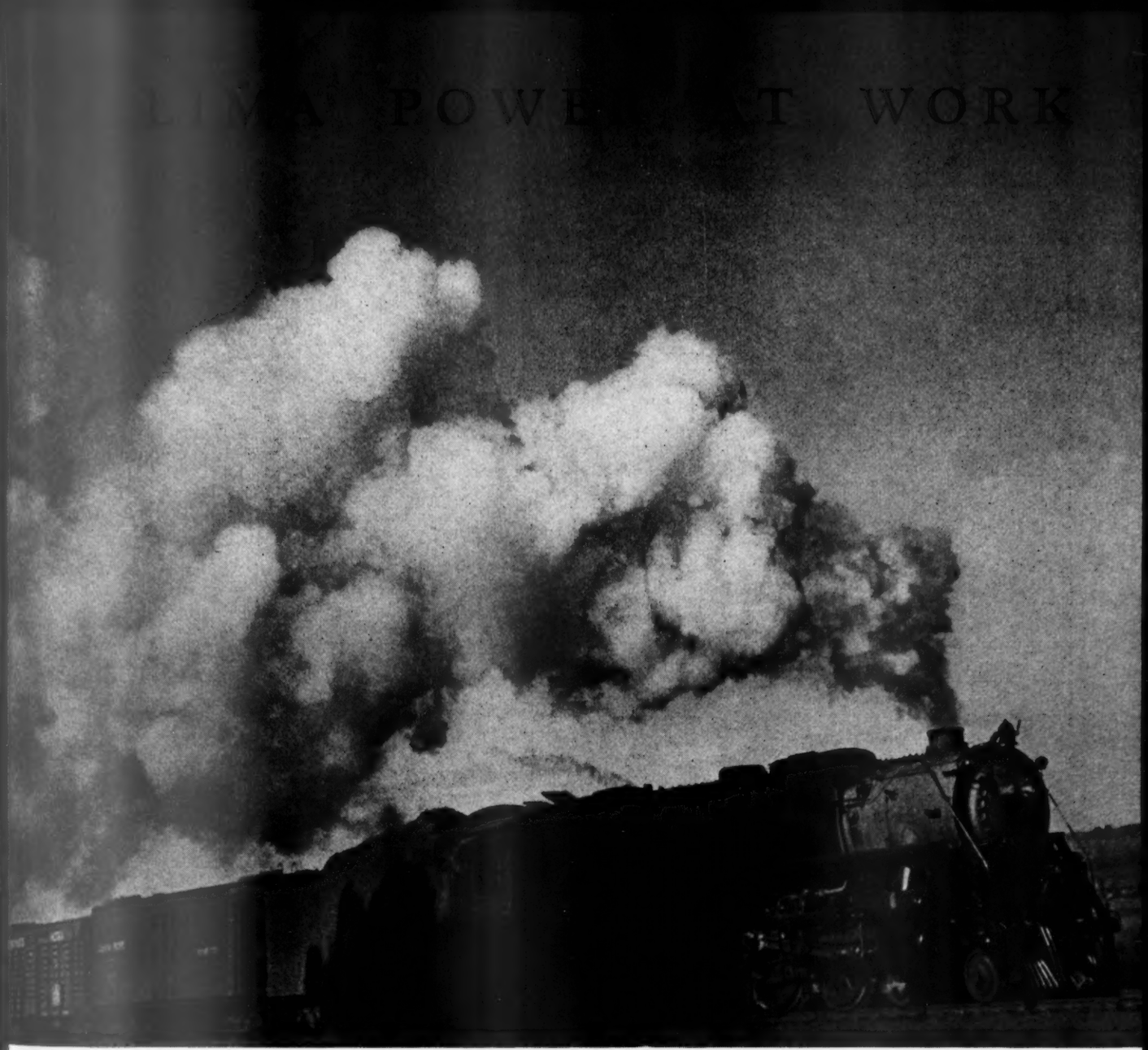



*Lima-built 4-8-4 handling fast freight on The Soo Line*

# MODERN POWER has set today's standards . . . and only Modern Power can meet them

**Modern Power hauling full capacity trains at high speeds has proved to be the most effective means of increasing earnings. Only Modern Power is capable of hauling these increased loads at the higher speeds necessary to secure LOWER OPERATING COSTS.**

**LIMA LOCOMOTIVE WORKS, INCORPORATED, LIMA, OHIO**

LIMA LOCOMOTIVE WORKS INCORPORATED

200 hopper cars of 55 tons' capacity will be purchased or be built in company shops. The seven 2,000 hp. locomotive units which the Burlington will buy, are to be streamlined and built of stainless steel. Six of the units will be operated in pairs on the Exposition Flyer and the Aristocrat, while the remaining unit will be held available for substitute duty on these trains and on the Denver and Twin Zephyrs.

*Chicago, Milwaukee, St. Paul & Pacific.*—The C. M. St. P. & P. has asked the Interstate Commerce Commission to approve a plan whereby the Reconstruction Finance Corporation would be asked to purchase $5,080,000 of 2½ per cent equipment trust certificates which constitutes 80 per cent of the cost of purchasing 10 freight locomotives and 2,000 50-ton box cars.

*Chicago, Rock Island & Pacific.*—The district court has authorized the C. R. I. & P. to spend $4,375,000 for equipment and repairs. The program includes the purchase of ten 600 hp. Diesel-electric switching locomotives to cost $625,000; ten 300 hp. to cost $350,000 and 1,000 box cars to cost $2,800,000.

*Erie.*—The Erie has asked the Interstate Commerce Commission for its approval and has requested the Reconstruction Finance Corporation to purchase $3,000,000 of equipment trust certificates at par, the certificates to mature serially in semi-annual equal payments over a period of 10 years and to bear interest at the rate of 2½ per cent. The funds will be used in part payment of the purchase of 700 box cars, 250 gondola cars, 500 hopper cars and 50 flat cars, the company to pay at least 20 per cent of the purchase price in cash.

*Illinois Central.* — The Illinois Central has applied for Interstate Commerce Commission approval of a $5,000,000 loan which it is seeking from the Reconstruction Finance Corporation to finance repairs to 51 locomotives and 11,000 freight cars. The loan would run for three years with interest at 2½ per cent. The application states that the I. C. expects that the repair of the 11,000 cars will permit it to reduce its car-hire expenses by an amount sufficient to offset the charges on the loan; while the additional motive power made available by repairing the 51 locomotives will enable the road to handle without loss to competing agencies all traffic anticipated in the near future.

*Minneapolis & St. Louis.* — The M. & St. L. will spend $1,210,000 in 1940 for improvements in addition to a regular maintenance expenditure of $2,925,000. Included in the improvements are 30 miles of new rails, 100 miles of new ballast, maintenance tools, the rebuilding of freight cars and locomotives and new machine tools.

*Minneapolis, Northfield & Southern.* — The M. N. & S. plans to purchase three Diesel-electric locomotives for $175,000.

*New York, New Haven & Hartford.* — The New Haven has placed orders totaling $2,110,000 for rails and new equipment, under federal court approval of the expenditure of $2,800,000 for such purposes in 1940. The cost of the rolling stock will be covered through the issuance of equipment trust certificates for the amount needed and the trustees have sufficient cash on hand to make considerable payments on other equipment which they plan to buy next year. In addition to orders for rail, orders were placed with the American Locomotive Company for 10 Diesel-electric switching locomotives of 660 hp. each; with the Pullman-Standard Car Manufacturing Company for 25 steel caboose cars to be built at Worcester, Mass., and also with Pullman-Standard for 250 high-side, 50-ton coal cars.

The New Haven now has over 1,200 men reconditioning its rolling stock at its Readville, Mass., shops under a $2,000,000 program in anticipation of possible increases in passenger and freight traffic. In the locomotive shops 665 men are at work and by the end of this year the New Haven expects to have over 270 locomotives, from the smallest to the largest, in shape for service at a cost of about $1,500,000. The first of these entered the locomotive shops early last December. In addition, over 250 cars for use in passenger service are being rebuilt including 102 passenger coaches, 100 baggage cars, 25 streamline coaches, 13 mail cars, 8 combination mail-baggage cars and 9 diners. Many of these already are back in service. The freight car shops recently completed repairs on 207 box cars, and are overhauling 100 low-side coal car and 33 flat cars for work service.

*The Pennsylvania.* — Eighty-five steel coaches will be remodeled in the Altoona, Pa., shops of the Pennsylvania, the work to be started before the close of the year and completed by June 1. Of the 85 cars, 25 will have the interiors constructed in accordance with the Pennsylvania's new long-distance overnight coach design. They will be equipped with individually adjustable reclining and revolving seats for 56 passengers and the exteriors will be streamlined. The remaining 60 will conform with the railroad's new interior coach design for through service not involving overnight travel.

*St. Louis-San Francisco.*—The St. L.-S. F. will rebuild 1,500 freight cars during 1940.

*St. Louis Southwestern.* — The federal district court has authorized the expenditure of $501,658 for materials to be used in the construction of 100 general service coal cars, six flat cars, and 12 automobile cars, and the rebuilding of 50 flat cars.

*Wabash.* — The Wabash will convert 1,000 automobile cars to steel-sheathed box cars. The company has also asked the Interstate Commerce Commission for approval of a loan and the Reconstruction Finance Corporation for a loan of $9,300,000, of which $6,500,000 is to be applied to the retirement of a similar amount of equipment notes issued by the company to the R. F. C., and $2,800,000 to be applied to the cost of repairing and rehabilitating 1,694 automobile box cars.

*Wheeling & Lake Erie.*—The W. & L. E. has asked the Interstate Commerce Commission for authority to assume liability for $1,200,000 of 2½ per cent equipment trust certificates, series F, to be dated November 15, 1939, and to mature serially in equal annual installments on November 15, in each of the years from 1940 to 1949, inclusive. The proceeds will be used to purchase 500 all-steel self-clearing hopper cars and 200 lightweight Cor-Ten steel box cars of 50-ton capacity.

## Mills Becomes I. C. C. Safety Bureau Director

SHIRLEY N. MILLS, assistant director of the Interstate Commerce Commission's Bureau of Safety since 1919, has been appointed director to succeed W. J. Patterson, who has been a member of the commission since July 31, having been appointed by President Roosevelt to succeed former Commissioner B. H. Meyer. James S. Hawley, attorney in the I. C. C. Bureau of Safety, succeeds Mr. Mills as assistant director.

Mr. Mills has been identified with I. C. C. safety work for 33 years, having been given that assignment when he joined the staff in 1906. He has been in the employment of the Bureau of Safety continuously since its organization in 1911.

From 1907 until 1912 Mr. Mills was assigned to the Block Signal and Train Control Board, a body of experts employed by the commission to investigate, conduct experimental tests and report upon the use of and necessity for block signal systems, automatic train control devices and other appliances, methods and systems designed to promote the safety of railroad operation. From 1912 to 1914 he was assigned to the Bureau of Safety to continue such investigations and tests, having meantime worked with that Bureau since its establishment on the inauguration of its system of investigating railroad accidents. From 1914 until 1919 Mr. Mills was a Bureau of Safety inspector engaged primarily in investigations and service tests of safety devices and systems and in investigations of accidents.

S. N. Mills

It was in 1919 that the new director became assistant director of the Bureau, and he had been senior assistant director since March 1, 1934. During this post-1919 period Mr. Mills has frequently served as acting director during absences of the director; and during the past two years he supervised the preparation of rules, standards and instructions for the installation, inspection, maintenance and repair of sig-

(*Continued on second left-hand page*)

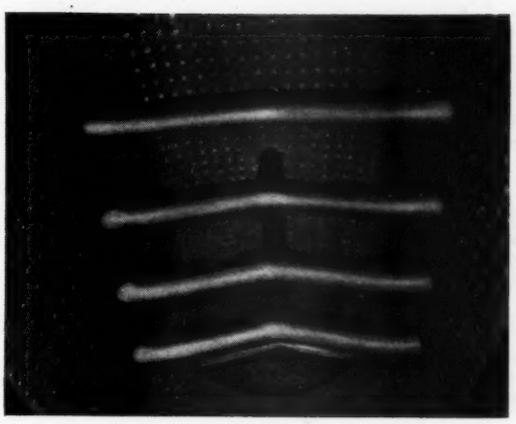
# SUCCESSFUL OPERATION

## . . . HAVE PROVED THE SECURITY CIRCULATOR

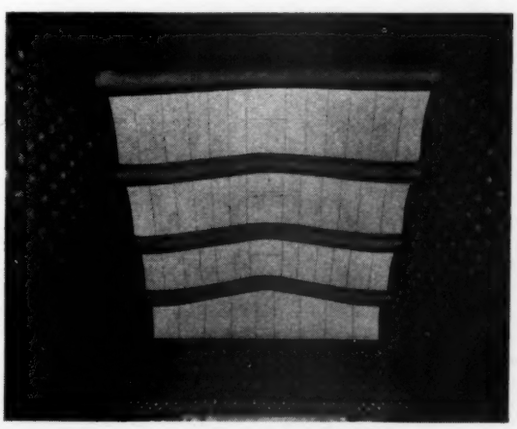
218 Security Circulators (157 of which were installed during the past 14 months) have been installed on 17 railroads, and have operated over 2¼ million locomotive miles in heavy, fast freight and passenger service.

Some of these Circulator-equipped locomotives have operated nearly 300,000 miles.

The Security Circulators in service have proved so successful that an additional 142 Circulators are now on order.



View illustrating the positioning of Security Circulators in an average size of locomotive firebox prior to installing the brick arch.



Typical Security Circulator and brick Arch Installation in a locomotive firebox. The small sectional brick are as readily applied as in an ordinary arch tube firebox.

**ARCH COMPANY, INC.**

***Security Circulator Division***

nal appliances and systems recently prescribed by the commission under the Signal Inspection Act of 1937. Also he supervised the development of administrative practices and procedures under that 1937 law which was one of railroad labor's "make-work" measures.

## D. L. & W. Seeking Shop Tools and Equipment

THE Delaware, Lackawanna & Western is in the market for 176 miscellaneous shop tools and equipment including approximately 12 large machine tools, which will be installed in its locomotive shops and its car shops.

## Brake-Hanger Wear Blocks—A Correction

THE brake-hanger wear blocks, described in an illustrated article on page 396 of the October, 1939, *Railway Mechanical Engineer*, were incorrectly stated to be supplied by the T-Z Railway Equipment Company which, as a matter of fact, has never manufactured or sold any kind of a wear block for this particular service. Brake-hanger wear blocks of somewhat similar design are now widely and successfully used by the railroads, being supplied by the Illinois Railway Equipment Company, Chicago.

## Equipment Depreciation Orders

EQUIPMENT depreciation rates for nine railroads, including the Maine Central, the Missouri-Kansas-Texas and the Southern, are prescribed by the Interstate Commerce Commission in a new series of sub-orders and modifications of previous sub-orders in No. 15,100, Depreciation Charges of Steam Railroad Companies. The composite percentages, which are not prescribed rates, range from 2.69 per cent for the Copper Range to 3.68 per cent for the Smoky Mountain, the higher composite percentage of 6.21 per cent listed for the Beaver, Meade & Englewood being merely the prescribed rate for that road's freight cars, the only figure in the present modification of a previous sub-order applicable to the B. M. & E.

The Maine Central's composite percentage of 3.11 is derived from a variety of prescribed rates on equipment owned and leased. On equipment owned the prescribed rates are as follows: Steam locomotives, 2.98 per cent; other locomotives, 6.43 per cent; freight train cars, 2.74 per cent; passenger train cars, 2.54 per cent; work equipment, 3.46 per cent; miscellaneous equipment, 20 per cent. On equipment leased from the Portland & Rumford Falls: Steam locomotives, 4.12 per cent; freight train cars, 11.83 per cent; passenger train cars, 12.3 per cent; work equipment, 3.87 per cent. On equipment leased from the Portland & Ogdensburg: Steam locomotives, 8.01 per cent; freight train cars, 13.8 per cent; passenger train cars, 14.15 per cent; work equipment, 6.04 per cent. On equipment leased from the European & North American: Steam locomotives, 8.84 per cent; freight train cars, 12.25 per cent; passenger train cars, 12.52 per cent; work equipment, 6.62 per cent.

The composite percentage for the M-K-T is 3.45 per cent, derived from prescribed rates as follows: Steam locomotives, 3.45 per cent; freight train cars, 3.26 per cent; passenger train cars (owned), 3.9 per cent; passenger train cars (leased), 3.15 per cent; work equipment, 4.04 per cent; miscellaneous equipment, 12.07 per cent. Prescribed rates for the Missouri-Kansas-Texas of Texas (composite percentage, 3.41) are as follows: Steam locomotives, 3.31 per cent; freight train cars, 4.93 per cent; passenger train cars (owned), 3.24 per cent; passenger train cars (leased), 3.7 per cent; work equipment (owned), 3.19 per cent; work equipment (leased), 4.2 per cent; miscellaneous equipment, 7.34 per cent.

The composite percentage for the Southern is 2.99 per cent, derived from prescribed rates as follows: Steam locomotives, 2.7 per cent; freight train cars, 3.25 per cent. Diesel-electric passenger-train equipment, 4.5 per cent; passenger-train equipment other than that in Diesel-electric trains, 2.5 per cent; floating equipment, 2.75 per cent; work equipment, 3.15 per cent; miscellaneous equipment, 8.04 per cent.

## New Equipment Orders and Inquiries Announced Since the Closing of the October Issue

### LOCOMOTIVE ORDERS

| Road | No. of Locos. | Type of Loco. | Builder |
|---|---|---|---|
| Boston & Maine | 3 | 600-hp. Diesel-elec. | Electro-Motive Corp. |
| | 1 | 600-hp. Diesel-elec. | American Loco. Co. |
| Canadian National | 15 | ..... | Montreal Loco. Wks. |
| | 10 | ..... | Canadian Loco. Co. |
| Canadian Pacific | 12 | ..... | Montreal Loco. Wks. |
| | 12 | ..... | Canadian Loco. Co. |
| Central of Brazil | 7[1] | 2-10-4 | American Loco. Co. |
| | 10[1] | 2-10-4 | Baldwin Loco. Wks. |
| Chicago & North Western | 2[2] | 3-unit Diesel-elec. | Electro-Motive Corp. |
| Chicago, Milwaukee, St. Paul & Pacific | 10[3] | 4-8-4 | Baldwin Loco. Wks. |
| Ford Motor Co. | 3 | Diesel-elec. & switch | General Electric Co. |
| Illinois Central | 7 | 600-hp. Diesel-elec. | Electro-Motive Corp. |
| | 1 | 1,000-hp. Diesel-elec. | |
| | 2 | 2,000-hp. Diesel-elec. | |
| St. Louis-San Francisco | 10[4] | Freight | Company shops |
| Sorocabana Rwy. (Brazil) | 4[5] | 4-10-2 | American Loco. Co. |

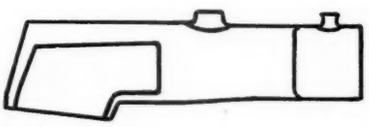
### LOCOMOTIVE INQUIRIES

| Road | No. of Locos. | Type of Loco. | Builder |
|---|---|---|---|
| Chilean State Rwys. | 10 | 4-8-2 | ..... |
| | 6 | 2-8-2 | ..... |

### FREIGHT CAR ORDERS

| Road | No. of Cars | Type of Car | Builder |
|---|---|---|---|
| Atchison, Topeka & Santa Fe | 1,800 | 40-ton box | Pullman-Std. Car Mfg. Co. |
| | 300 | 40-ton refrigerator | General American |
| | 100 | 50-ton refrigerator | |
| | 50 | 100-ton refrigerator | |
| | 100 | 70-ton flat | |
| | 50 | 70-ton gondola | |
| | 200 | 70-ton ballast | Rodger Ballast |
| | 200 | 50-ton gondola | American Car & Fdry. Co. |
| Baltimore & Ohio | 500 | 70-ton gondola | American Car & Fdry. Co. |
| | 1,000 | 50-ton hopper | Bethlehem Steel Co. |
| | 500 | Box | Pressed Steel Car Co. |
| Bessemer & Lake Erie | 1,000 | 90-ton hopper | Pullman-Std. Car Mfg. Co. |
| | 500 | 50-ton gondola | Pressed Steel Car Co. |
| | 500 | 50-ton box | Greenville Steel Car Co. |
| | 50 | Hopper | American Car & Fdry. Co. |
| Canadian National | 1,075 | Box | Eastern Car Co. |
| | 590 | Box | National Steel Car Corp. |
| | 1,100 | Box | Canadian Car & Fdry. Co. |
| | 500 | Flat | |
| Canadian Pacific | 200 | Refrigerator | National Steel Car Corp. |
| | 500 | Box | |
| | 500 | Box | Canadian Car & Fdry. Co. |
| | 100 | Automobile | |
| Central of Brazil | 100 | 30-ton flat | American Car & Fdry. Co. |
| | 200 | 30-ton box | |
| | 200 | 30-ton gondola | |
| | 250 | Box | Pullman-Std. Car Exp. Corp. |
| | 150 | Flat | |
| | 100 | Gondola | |
| Chicago & Illinois Midland | 50 | Hopper | Pullman-Std. Car Mfg. Co. |
| Chicago Great Western | 100 | 50-ton flat | Pullman-Std. Car Mfg. Co. |
| Chicago, Milwaukee, St. Paul & Pacific | 2,000[3] | 50-ton box | Company shops |
| Chicago, Rock Island & Pacific | 1,000 | 50-ton box | Pressed Steel Car Co. |
| Elgin, Joliet & Eastern | 600 | 50-ton twin hopper | American Car & Fdry. Co. |
| | 50 | 50-ton covered hopper | |
| Great Northern | 750 | 75-ton ore | Pressed Steel Car Co. |
| | 750 | 75-ton ore | Bethlehem Steel Co. |
| Inland Steel Co. | 50 | 70-ton mill-type gondola | General American |
| Lehigh & New England | 75[6] | 70-ton hopper-bottom | American Car & Fdry. Co. |
| Louisiana & Arkansas | 300 | 50-ton box | American Car & Fdry. Co. |
| Louisville & Nashville | 600 | 50-ton hopper | American Car & Fdry. Co. |
| | 600 | 50-ton hopper | Pullman-Std. Car Mfg. Co. |
| Maine Central | 10 | 70-ton hopper | American Car & Fdry. Co. |
| Nevada Consolidated Copper Co. | 30 | Air-dump | Austin-Western Rd. Mchy. Co. |
| Northern Pacific | 500 | 50-ton box | American Car & Fdry. Co. |
| | 150 | 50-ton hopper | |
| | 200 | Hopper | General American |
| | 500 | Box | Pullman-Std. Car Mfg. Co. |
| | 500 | Gondola | Pressed Steel Car Co. |
| | 50 | Hopper | American Car & Fdry. Co. |
| | 100 | 70-ton ballast | |
| St. Louis Southwestern | See footnote[7] | | |
| Seaboard Air Line | 700 | 50-ton box | Pullman-Std. Car Mfg. Co. |
| | 100 | 70-ton hopper | Bethlehem Steel Co. |
| | 100 | 50-ton flat | American Car & Fdry. Co. |
| Tennessee Central | 65 | 50-ton hopper | American Car & Fdry. Co. |

*(Continued on next left-hand page)*



*Less*

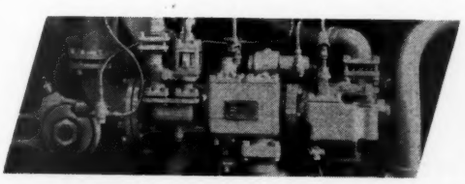
**Boiler Maintenance**

when the boiler feed-water is preheated at all times, and...

*Less*

**Maintenance on the Pumping Equipment**

when it is an Elesco Exhaust Steam Injector, as there are no continuously moving parts to maintain.



ELESCO

A-1368

# THE SUPERHEATER COMPANY

Representative of AMERICAN THROTTLE COMPANY, INC.

60 East 42nd Street, NEW YORK 122 S. Michigan Avenue, CHICAGO

Canada: THE SUPERHEATER COMPANY, LTD., MONTREAL

Superheaters • Exhaust Steam Injectors • Feedwater Heaters • American Throttles • Pyrometers • Steam Dryers

## New Equipment Orders and Inquiries

(*Continued from page 519*)

FREIGHT-CAR ORDERS

| | | | |
|---|---|---|---|
| Texas & Pacific | 500 | 50-ton box | Mt. Vernon Car Mfg. Co. |
| Union Railroad Co. | 60 | Air-dump | Differential Steel Car Co. |
| | 40 | Air-dump | Magor Car Corp. |
| U. S. Navy Dept., Bureau of Supplies and Accounts | 15 | 50-ton flat | |
| | 8 | 50-ton box | American Car & Fdry. Co. |
| | 8 | 50-ton gondola | |
| | 1 | 50-ton hopper | |
| | 17 | Flat | Haffner-Thrall Car Co. |
| U. S. War Dept., Chief of Engineers | 125 | Tank | American Car & Fdry. Co. |
| Utah Copper Co. | 100 | 100-ton ore | Pressed Steel Car Co. |
| Youngstown & Northern | 100 | 70-ton gondola | Magor Car Corp. |

FREIGHT-CAR INQUIRIES

| Road | No. of Cars | Type of Car | Builder |
|---|---|---|---|
| Atchison, Topeka & Santa Fe | 27 | 80-ton ore | ..... |
| Delaware, Lackawanna & Western | 500 | 50-ton box | ..... |
| | 500 | 50-ton hopper | ..... |
| | 100 | 70-ton gondola | ..... |
| Lehigh Valley | 200-300 | 70-ton gondola | ..... |
| | 50 | 70-ton gondola | ..... |
| New York, New Haven & Hartford | 500-1,000 | 50-ton box | ..... |
| Norfolk & Western | 1,000 | 70-ton hopper | ..... |
| Union Pacific | 500-1,000 | 50-ton ballast | ..... |

PASSENGER-CAR ORDERS

| Road | No. of Cars | Type of Car | Builder |
|---|---|---|---|
| Canadian Pacific | 10 | Mail and express | Natl. Steel Car Corp. |
| Chicago & North Western | 28[2] | ..... | Pullman-Std. Car Mfg. Co. |

[1] These locomotives will be of meter gage and will have 20-in. by 24-in. cylinders, 48¼-in. drivers, and will weigh 248,000 lb. in working order.

[2] The Chicago & North Western has been authorized by the federal district court to participate to the extent of $700,000 in the purchase of two 14-car streamlined trains, which will cost $3,270,000, and which will be placed in operation between Chicago and California. Both trains will be hauled by three locomotive units of 2,000 hp. each to be built by the Electro-Motive Corporation. The 28 revenue cars comprising the train will be of lightweight construction, and will be built by the Pullman-Standard Car Manufacturing Company. Of these 28 cars, 15 roomette double bedroom compartment, master bedroom and section cars will be owned by the Pullman Company, while 13 baggage, dining, coach and observation cars will be owned by the railroads. One train, the new Forty-Niner, will be owned jointly by the Chicago & North Western, the Union Pacific, and the Southern Pacific, and will be operated between Chicago and San Francisco. The new City of Los Angeles will be owned jointly by the Chicago & North Western and the Union Pacific, and will operate between Chicago and Los Angeles. The present equipment of these trains will be used elsewhere.

[3] Authorized by federal district court.

[4] To be constructed in 1940. They are in addition to five now nearing completion.

[5] These locomotives will be of meter gage and will have three cylinders, two of 17½ in. by 24 in. and one of 17½ in. by 22 in. They will have 48- in. driving wheels and will weigh 246,000 lb. in working order.

[6] Special type hatchway roof, hopper bottom cars for bulk cement loading.

[7] The St. Louis Southwestern has ordered from the American Car & Foundry Co., 100 car sets of steel underframes and superstructures and fabricated steel parts for 40-ft. convertible ballast and coal cars. An order has also been placed for 56 steel underframes for flat cars of 40 tons' capacity and 42 ft. long.

## I. C. C. Organization Changes

SEVERAL changes in the organization of the Interstate Commerce Commission's work were announced in an August 9 notice by Secretary W. P. Bartel. Under the new set-up the Bureau of Valuation will report to Commissioner Miller instead of Commissioner Lee; the Bureau of Informal Cases will report to Commissioner Lee instead of Commissioner Caskie; the Bureaus of Safety and Locomotive Inspection will report to Commissioner Patterson instead of Commissioner Miller; and Commissioner Patterson has been made a member of Division 3 in lieu of Commissioner Miller.

Under the I. C. C.'s internal reorganization plan which became effective in July, as reported in the July *Railway Mechanical Engineer*, page 301, Division 3 is the one which administers the Safety Appliance and related acts, such as Locomotive Inspection, Transportation of Explosives; emergency directions as to car service; pooling of traffic; and the classification of railroad employees under the Railroad Retirement Act and the Railroad Unemployment Insurance Act.

## Pioneer Zephyr in Collision with Freight Locomotive

THE "Pioneer Zephyr" of the Chicago, Burlington & Quincy, while en route from Kansas City, Mo., to Omaha, Neb., on October 2, encountered an open switch and collided with a freight locomotive which was taking water near Napier, Mo. The engineman of the Zephyr was killed and five other trainmen were injured. The accident occurred while the train was passing through the yards at Napier.

## Equipment Installations and Orders Since January 1

NEW freight cars placed in service or ordered by the Class I railroads in the first nine months this year totaled 37,757, according to the Association of American Railroads. Of that number 14,704 have been put in service since January 1 this year and 23,053 were on order on October 1, 1939.

Class I railroads in September placed orders for 16,497 new freight cars, which exceeded by 1,793 cars the number of new freight cars put in service in the first nine months this year. Of the total number for which orders were placed in September, 10,774 were coal cars and 5,413 were box cars. Orders also were placed for 310 new flat cars. Out of the 23,053 new freight cars on order, 4,835 are to be built in railroad shops while the remainder are to be constructed by private car-building concerns.

New steam locomotives on order on October 1, 1939, totaled 68, of which five were ordered in September. New electric and Diesel-electric locomotives on order on October 1 totaled 40, orders for nine having been placed in September.

New steam locomotives put in service in the first nine months totaled 45, 13 having been installed in September. New electric and Diesel-electric locomotives put in service in the nine months' period this year totaled 157 of which 23 were installed in September.

In the figures relating to new freight cars on order, only those for which orders have actually been placed up to October 1 this year are included. Freight cars and locomotives leased or otherwise acquired are not included.

## Second "Mercury" Completed

THE New York Central will place in service on November 12 between Chicago and Detroit the second "Mercury" train recently completed at its Beech Grove shops. The present Mercury, placed in service between Cleveland and Detroit in 1936, will be continued in that service.

The new train consists of a Hudson type passenger locomotive, painted in the Mercury's dark gray color scheme, and 11 cars, including a baggage car, six coaches, a dining car, a kitchen car, a lounge car and a parlor observation car. Although lighter than standard cars, they are full size and combine beauty with comfort and utility. The coaches have spacious vestibules, that are semi-circular and warmly colored and which make entrance and exit into the car with baggage much easier. Each coach has a smoking lounge for the use both of men and women passengers. Floors, walls and ceilings of the cars are insulated, while the trucks are equipped with roller bearings.

Dining facilities take up the entire dining car, which seats 56 persons, while the kitchen is in an adjoining car. The former is divided by glass partitions into three dining rooms, the center room having banquet seats along the sides. A waiting room, seating six, at one end is another feature of this car. An electric eye operates the head-end door leading into the kitchen car.

The lounge car has a semi-circular service bar, located midway in the car. The parlor observation car has a solarium with leather seats facing outward.

## President Brown of Johns-Manville Receives Franklin Institute Medal

LEWIS H. BROWN, president, Johns-Manville Corporation, New York, will be awarded the W. M. Vermilye medal, "in recognition of outstanding contribution in the field of industrial management," by the Franklin Institute, Philadelphia, Pa., on November 14. The first recipient of the award, Mr. Brown has been president of Johns-Manville since 1929. His selection is based upon the report of an advisory committee which includes W. L. Batt, chairman, president of SKF Industries; C. E. Brinley, president, Baldwin Locomotive Works; and R. A. Wentworth, representing the American Society of Mechanical Engineers.

# Supply Trade Notes

OTTO V. KRUSE has been elected a member of the board of directors of the General Steel Castings Corporation, Eddystone, Pa. Mr. Kruse is general sales manager of the Baldwin Locomotive Works.

◆

THE MARKHAM SUPPLY COMPANY, 310 South Michigan avenue, Chicago, has been appointed railway sales representative of the H. K. Porter Company, Inc., Pittsburgh, Pa.

◆

HENRY N. GARDNER has been elected vice-president of the Hullson Grate Company, Keokuk, Iowa, in charge of sales in the eastern territory. Mr. Gardner, who is located at 35 Astral avenue, Providence,

**H. N. Gardner**

R. I., was born in South Swansea, Mass., on April 28, 1896. He completed public school and business college courses at Fall River, Mass., and for a short time served the New England Steamship Company in clerical capacities. He then became a service man and salesman in the employ of the Packard Motor Company, Inc., at Providence. In 1916 he entered the service of the New York, New Haven & Hartford as a locomotive fireman, advancing to locomotive engineman in 1926. In September, 1927, Mr. Gardner became service engineer of the Hulson Grate Company, and from 1934 until his election as vice-president he was special representative, sales, tests and service, eastern territory.

◆

THE SYMINGTON-GOULD CORPORATION, Rochester, N. Y., has dissolved its wholly owned subsidiary, Gould Coupler Corporation. The Depew plant will be operated as the Gould Coupler Works of the Symington-Gould Corporation, with no change in local management.

◆

THE LINDE AIR PRODUCTS COMPANY, the Oxweld Railroad Service Company, the Carbide & Carbon Chemicals Corporation, the Union Carbide Company, the Electro Metallurgical Company and the Haynes Stellite Company, units of the Union Carbide & Carbon Corp., have moved their general publicity department headquarters from 205 East Forty-second street, New York, to the Carbide & Carbon building, 30 East Forty-second street, New York.

◆

E. T. SCHROEDER, Syndicate Trust building, St. Louis, Mo., has been appointed representative in the Southwest for the Valve Pilot Corporation, New York. Rowland S. Folk has joined the staff of the Valve Pilot Corporation, attached to its sales organization in its New York office.

◆

R. CARSON DALZELL has been appointed technical adviser of the Baltimore division of the Revere Copper and Brass Incorporated, with headquarters at 1301 Wicomico street, Baltimore, Md.

## Obituary

CHARLES C. KING, of the railroad department of the Detroit Lubricator Company, Detroit, Mich., died suddenly in that city on September 24.

◆

W. A. BERGER, sales engineer and eastern representative of W. H. Miner, Inc., with headquarters at Chicago, died in that city on October 4.

◆

WILLIAM G. TAWSE, service engineer for The Superheater Company, with headquarters at Chicago, died on October 5. Mr. Tawse was born in 1870 at Aberdeen, Scotland. At the age of 18 he started his railroad career with the Grand Trunk. In July, 1894, he served as a locomotive engineman on the Baltimore & Ohio, and in 1902 was promoted to fuel supervisor. The following year he was transferred to the Chicago & Eastern Illinois as road foreman of engines. In January, 1911, Mr. Tawse joined The Superheater Company as service engineer out of Chicago. In 1914 he was transferred to the Pacific Coast, where he continued to represent the company until his demise. He took a prominent part in the work of the Traveling Engineers' Association and was identified with several other associations.

◆

ARTHUR L. HUMPHREY, who retired as chairman of the executive committee of the Westinghouse Air Brake Company on December 31, 1938, died at his Edgewood home, Pittsburgh, Pa., on November 1, following a lingering illness. Comparatively inactive for the past year, Mr. Humphrey had been identified continuously with the Westinghouse Air Brake Company since his affiliation in 1903 as western manager, with headquarters in Chicago. From the general managership of the company, which he assumed in 1905, at which time he moved to Pittsburgh, he rose successively to the position of vice-president and general manager in 1910; was elected a director in 1913, and succeeded to the presidency in 1919, at which time he also became a member of the executive committee. In 1932 he became an executive director; in 1933, chairman of the board, and in 1936, chairman of the executive committee.

Mr. Humphrey gained national prominence for his services during the World War. In addition to the extensive activities of the companies which he headed in producing munitions, he was industrial "staff expert" for Brig. Gen. C. C. Williams, chief of the Ordnance Department. He was also a member of the Committee on Labor of the Council of National Defense, as well as a member of the War Industries Board and the War Resources Committee.

Born in Buffalo, N. Y., June 12, 1860, Mr. Humphrey was taken when one year of age to the farming region of the Midwest, where he attended the country schools of Maquoketa, Iowa, and Plattsmouth, Neb. He left the farm at the age of 14, taking a position as a drug clerk in Plattsmouth. In 1877 he became a machinist apprentice on the Burlington & Missouri River Railroad, a part of what is now known as the Chicago, Burlington & Quincy Railroad. At the age of 22 he organized a general machine shop and foundry in Seattle, Wash., which afterwards became the Moran Iron Works. He re-entered railway service and became constructing division foreman of the Mojave division of the Central Pacific, then master mechanic, and later superintendent motive power of the Colorado Midland. He became interested in politics and was elected to the Colorado House of Representatives in 1892. Re-elected, he served as Speaker of the House during his second term. He returned to railroad service on the Colorado

**A. L. Humphrey**

& Southern in 1899 and in 1903 went to the Chicago & Alton as superintendent of motive power. This position he relinquished to join the Westinghouse Air Brake Company in the capacity of western manager, with headquarters in Chicago, in 1903. Among the many other organizations with which Mr. Humphrey was associated either as a director or as an executive were the following: Union Switch & Signal Company, Pittsburgh; National Brake & Electric Company, Milwaukee; Westinghouse International Brake & Sig-

(*Continued on second left-hand page*)

for FREIGHT and
GM
GENERAL MOTORS
DIESEL
POWER
NEW YORK CENTR
575

# PASSENGER *Terminals*

# YOU CAN NOT BEAT DIESEL OPERATION

## *because*

- **Fuel costs are reduced 75 per cent and overall locomotive costs reduced 50 per cent.**
- **EMC Availability has averaged 94 per cent resulting in fewer locomotives required to handle 24-hour operation.**
- **Diesel efficiency is uniformly high throughout entire year.**
- **EMC "Clear-View" type locomotives give superior visibility, permitting faster and safer switching.**
- **High starting tractive effort enables Diesels to start heavy trains and negotiate steep grades.**
- **Rapid and smooth acceleration and deceleration speed up yard movements.**
- **Exact power control at all speeds reduces coupling shocks to passengers and minimizes damage to cars and lading.**
- **Expensive supporting facilities such as coal docks, ash pits, water stations, are eliminated at fully Dieselized terminals.**
- **EMC Diesels pave the way to added economies and benefits resulting from cleaner, quieter and smokeless operation.**

**Frequently EMC Diesel Switchers save $1000.00 per month over carrying and amortization charges and pay for themselves in five years. No other type of motive power can match these savings.**

ELECTRO-MOTIVE CORPORATION

*SUBSIDIARY OF GENERAL MOTORS* LA GRANGE, ILLINOIS, U. S. A.

nal Company; American Brake Company of St. Louis; American Brake Shoe & Foundry Company; Canadian Westinghouse Company, Ltd., of Hamilton, Canada; Safety Car Devices Company; Westinghouse Pacific Coast Brake Company of Emeryville, Cal.; Westinghouse Traction Brake Company; Bendix Westinghouse Automotive Air Brake Company; Westinghouse Electric & Manufacturing Company; Wilmerding Corporation; trustee of the University of Pittsburgh.

◆

ERNEST A. LEBEAU, representative of the Chicago Railway Equipment Company, with headquarters at Chicago, died in that city on October 1. He had been ailing since January.

◆

FREDERICK C. CAMERON, until recently assistant director of sales at the Corning Glass Works, Corning, N. Y., died on September 29, at his home in Corning, after an extended illness.

# Personal Mention

## General

CHARLES J. SCUDDER, chief of motive power of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., has been relieved of the duties of that position at his own request and has been appointed consulting engineer of motive power. Mr. Scudder was born at Saginaw, Mich., on September 21, 1873, and entered railway service in 1888 as a machinist apprentice on the Flint & Pere Marquette (Pere Marquette). In 1898, he became machinist on the Detroit, Grand Rapids & Western (Pere Marquette) at Ionia, Mich., and in 1906, became master mechanic on the Cincinnati, Hamilton & Dayton (Baltimore & Ohio) at Cincinnati, Ohio. Mr. Scudder was appointed general foreman, Pere Marquette, at Chicago, in 1908; superintendent shops at Saginaw, Mich., in 1909; and master mechanic in 1910. In 1911 he became a locomotive inspector of the Interstate Commerce Commission and in 1917 was appointed supervisor of equipment, United States Railroad Administration. Mr. Scudder was appointed superintendent of shops for the Delaware, Lackawanna & Western at Scranton, Pa., in 1919 and became superintendent motive power and equipment at Scranton in 1923. He has been chief of motive power since 1936.

Charles J. Scudder

O. J. PROTZ, assistant master mechanic on the Chicago & North Western at Clinton, Iowa, has been promoted to superintendent of the locomotive and car shops at Chicago, succeeding George H. Logan, who has retired.

EDWARD E. ROOT, assistant chief of motive power of the Delaware, Lackawanna & Western, has been appointed chief of motive power, succeeding Charles J. Scudder. A photograph of Mr. Root and a biographical sketch of his railway career, were published in the July *Railway Mechanical Engineer* when he became assistant chief of motive power.

J. P. BECKER, master mechanic of the Chicago Great Western at Oelwein, Iowa, has been appointed assistant to superintendent of motive power, with headquarters at Oelwein. Mr. Becker, in this newly-created position, will have jurisdiction over matters pertaining to general locomotive inspection, design, standards and tests.

JOSE MORALES SANCHEZ, superintendent of motive power and machinery of the Southern Pacific of Mexico, with headquarters at Empalme, Son., Mex., has resigned to return to his former position of assistant general superintendent of motive power and machinery of the National Railways of Mexico, with headquarters at Mexico, D. F.

## Master Mechanics and Road Foremen

A. W. BYRON, master mechanic of the Pennsylvania at West Philadelphia, Pa., has been transferred to Wilmington, Del., and will succeed C. O. Shull.

C. T. HUNT, assistant master mechanic of the Pennsylvania at Mingo Junction, Ohio, has been appointed master mechanic at West Philadelphia, Pa., succeeding A. W. Byron.

C. O. SHULL, master mechanic of the Pennsylvania at Wilmington, Del., has been transferred to a similar position at Juniata, Pa. Mr. Shull was born on February 9, 1894, at Williamsport, Pa. He graduated from Cornell University in 1917. He began his railway service on August 5, 1909, being employed consecutively by the Pennsylvania as messenger, shop hand, apprentice, motive-power inspector, general foreman and assistant master mechanic. He then became successively master mechanic at Sharpsburg, Chicago, Pitcairn and Wilmington. His transfer to Wilmington was announced in the August issue.

## Car Department

K. H. CARPENTER, general car inspector of the Delaware, Lackawanna & Western at Scranton, Pa., has been appointed assistant superintendent of the car department with the same headquarters. The position of general car inspector has been abolished.

H. C. FISHER, foreman of the passenger car shop of the Norfolk & Western, has been appointed superintendent of the car department, with headquarters at Roanoke, Va., succeeding S. P. Seifert, retired.

CRESCENCIO NEAVES has been appointed master car builder of the National Railways of Mexico, succeeding Pedro Contreras, who has retired.

S. P. SEIFERT, superintendent of the car department of the Norfolk & Western at Roanoke, Va., has retired. Mr. Seifert entered the service of the Norfolk & Western in 1891 as a car builder. Two years later, he became gang foreman in the car department. He then served successively as assistant foreman, supervisor, and superintendent. For 21 years of his almost half-century service with the N. & W., Mr. Seifert was superintendent of the car department.

P. H. MITCHELL, master car builder of the Delaware, Lackawanna & Western, has been appointed superintendent car department, with headquarters at Scranton, Pa. Mr. Mitchell was born at Prescott, Ark. He entered railroad service as a car repairman with the Prescott & Northwestern and subsequently was employed as a car foreman on the Memphis, Dallas & Gulf (now part of the Graysonia, Nashville & Ashdown and the Murfreesboro-Nashville) at Nashville, Ark. Leaving that company

P. H. Mitchell

Mr. Mitchell entered the employ of the San Antonio, Uvalde & Gulf as air-brake inspector and steam-heat supervisor, later returning to the Memphis, Dallas & Gulf as master car builder. He was general car inspector of the Texas & Pacific, at Dallas, Tex., prior to entering the service of the Delaware, Lackawanna & Western in 1936. Mr. Mitchell served as general car inspector of the Lackawanna at Scranton until March, 1938, when he was appointed master car builder, a position which has now been abolished.